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ACCESSION NUMBER RANGES

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ENERGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 39

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between July 1 and September 30, 1983 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



Scientific and Technical Information Branch

1983

National Aeronautics and Space Administration

Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(39)) lists 1377 reports, journal articles, and other documents announced between July 1, 1983 and September 30, 1983 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Six indexes -- subject, personal author, corporate source, contract number, report number, and accession number -- are included.

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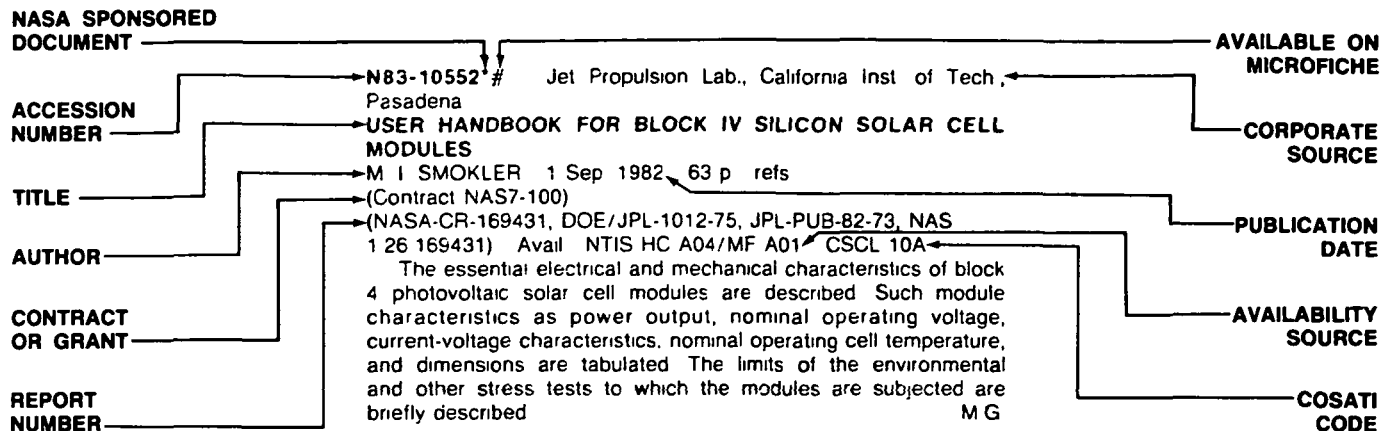
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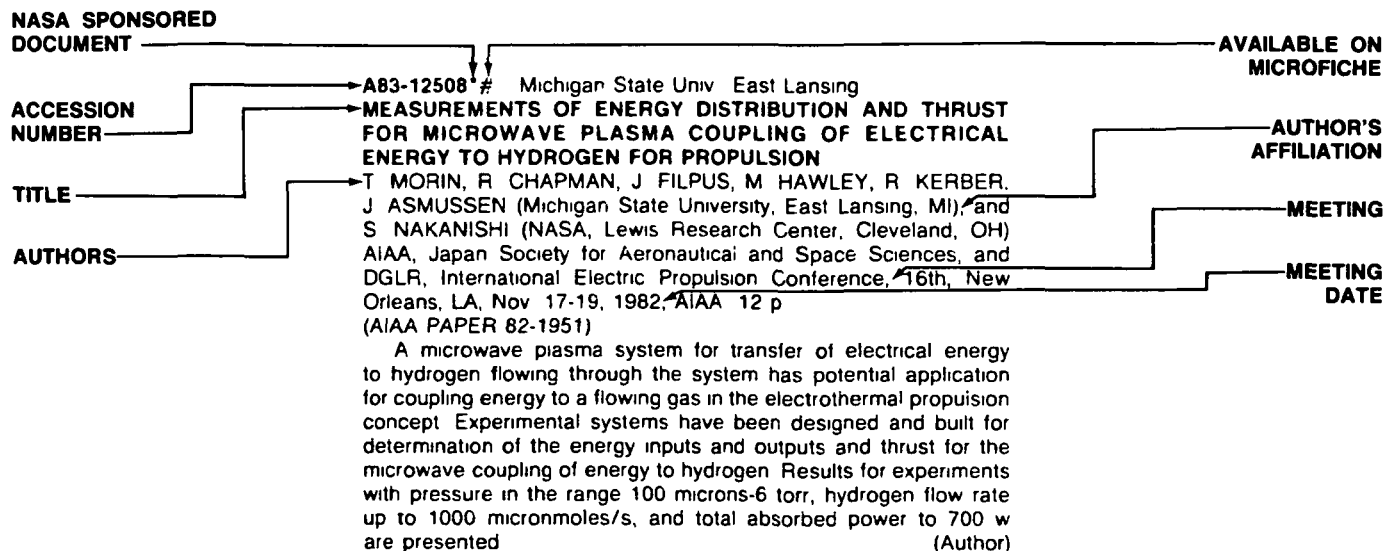
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A Listing of Energy Bibliographies Contained in This Publication:

1. Community energy management: An annotated bibliography

p200 N83-25046

OCTOBER 1983

01

ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A83-31507
**ENHANCEMENT OF QUALITY THROUGH ENVIRONMENTAL
TECHNOLOGY; PROCEEDINGS OF THE TWENTY-EIGHTH
ANNUAL TECHNICAL MEETING, ATLANTA, GA, APRIL 21-23,
1982**

Meeting sponsored by the Institute of Environmental Sciences.
Mt. Prospect, IL, Institute of Environmental Sciences, 1982, 296
p

Environmental issues are discussed under the following headings: environmental engineering methods, environmental stress impact, contamination control, and energy and environment. Papers are presented on an assessment of external stores reliability testing, optimization of classical shock waveforms, the development and production of advanced cooling techniques for hybrid microcircuits, and the isolation and molecular identification of ultramicro contaminants by Fourier transform infrared spectroscopy. Other topics discussed include features and testing of clean room apparel, the hazards from large spills of liquefied gaseous fuels, and a solar pond potential site survey for electrical power generation. V L.

A83-31596
**THE INTERACTION BETWEEN AIR POLLUTION DISPERSION
AND RESIDENTIAL HEATING DEMANDS**
F. W. LIPPERT, P. D. MOSKOWITZ, J. DUNGAN, J. TICHLER,
and T. CARNEY (Brookhaven National Laboratory, Upton, NY)
Air Pollution Control Association, Journal (ISSN 0002-2470), vol.
33, March 1983, p. 208-211. refs
(Contract DE-AC02-76CH-00016)

The effect of the short-term correlation of a specific emission (sulfur dioxide) from residential space heating, with air pollution dispersion rates on the accuracy of model estimates of urban air pollution on a seasonal or annual basis is analyzed. Hourly climatological and residential emission estimates for six U.S. cities and a simplified area source-dispersion model based on a circular receptor grid are used. The effect on annual average concentration estimations is found to be slight (approximately + or - 12 percent), while the maximum hourly concentrations are shown to vary considerably more, since maximum heat demand and worst-case dispersion are not coincident. Accounting for the correlations between heating demand and dispersion makes possible a differentiation in air pollution potential between coastal and interior cities. T.K.

A83-32576#
**ALL-ELECTRIC VS CONVENTIONAL AIRCRAFT - THE
PRODUCTION/OPERATIONAL ASPECTS**

M. J. CRONIN (Lockheed-California Co., Burbank, CA) Journal
of Aircraft (ISSN 0021-8669), vol. 20, June 1983, p. 481-486.

Previously cited in issue 14, p. 2298, Accession no.
A81-32909

A83-33503
**THE ATMOSPHERIC OXIDATION OF FLUE GASES FROM A
COAL-FIRED POWER PLANT - A COMPARISON BETWEEN
SMOG CHAMBER AND AIRBORNE PLUME SAMPLING**

M. LURIA (Jerusalem, Hebrew University, Jerusalem, Israel), K. J. OLSZYNA, and J. F. MEAGHER (Tennessee Valley Authority, Muscle Shoals, AL) Air Pollution Control Association, Journal (ISSN 0002-2470), vol. 33, May 1983, p. 483-487. Research supported by the U.S. Environmental Protection Agency and Tennessee Valley Authority. refs

A83-33545#
**ADVANCED NAVIGATION SYSTEMS AND FUEL
CONSERVATION**

C. H. SIMPSON (Air Canada, Montreal, Canada) Canadian
Aeronautics and Space Journal (ISSN 0008-2821), vol. 29, March
1983, p. 14-16.

Attention is confined to the savings that can be realized from improvements in operating procedures and navigation procedures, including advanced navigation systems. The Flight Management System is linked to the avionic flight control system on the L-1011-500 Tristar. The computer receives information from the engines, the central air data system, and the navigation receivers. It processes the information in accordance with a predetermined program and sends control signals to the autopilot and auto-throttle system. The way in which the Inertial Navigation System (Omega) works to ensure direct routings is discussed. The importance of air traffic controllers understanding that speed control is far more important than vectors in conserving fuel is stressed. C R

A83-34003
**SOOT CARBON AND EXCESS FINE POTASSIUM -
LONG-RANGE TRANSPORT OF COMBUSTION-DERIVED
AEROSOLS**

M. O. ANDREAE (Florida State University, Tallahassee, FL)
Science (ISSN 0036-8075), vol. 220, June 10, 1983, p.
1148-1151. refs

During a cruise from Hamburg to Montevideo, aerosol samples representing air masses from Europe, the Sahara, tropical Africa, South America, and open oceanic regions were collected. They showed significant amounts of soot carbon over large areas of the remote Atlantic, often similar to concentrations in rural continental areas. Back-trajectories and the ratios of soot carbon to total fine (less than 1.7 micrometers in diameter) carbon and of excess fine potassium (the portion not attributable to soil dust or sea salt) to soot carbon indicate that biomass burning in tropical regions is an important source of soot carbon to the world atmosphere. The ratio of excess potassium to soot carbon in the fine fraction of aerosols is proposed as an indicator of the relative contributions of biomass and fossil-fuel burning to soot carbon aerosols. The ratio of soot carbon to fine carbon suggests that

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

most of the particulate organic carbon over the Atlantic is of continental origin. Author

A83-34147

SOURCE RELIABILITY IN A COMBINED WIND-SOLAR-HYDRO SYSTEM

A. TRACA DE ALMEIDA, A. MARTINS, H. JESUS, and J. CLIMACO (Coimbra, Universidade, Coimbra, Portugal) (IEEE, ASME, ASCE, Joint Power Generation Conference, Denver, CO, Oct. 17-21, 1982) IEEE Transactions on Power Apparatus and Systems (ISSN 0018-9510), vol. PAS-102, June 1983, p. 1515-1520 Research supported by the Instituto Nacional de Investigacao Cientifica and Junta Nacional de Investigacao Cientifica e Tecnologica refs

The results of an examination of the feasibility of using coupled wind-solar-hydro power generation systems to provide all of Portugal's electricity by the year 2000 are reported Portugal used 15.6 TWh of electricity in 1981, of which hydro supplied 10 TWh. Demand is expected to reach 34 TWh in 2000 AD. The full development of hydropower resource would furnish 18 TWh and a storage capacity of 4.5 TWh. The installed hydro system could meet the peak demand of 6 GW, while solar cells and wind turbines must produce 16 TWh annually plus a reserve The Growian wind turbine, 100 m tall, is considered for its 2.2 MW output. A coastal strip of wind turbines 150 x 20 km, with 1 km spacing between the machines, would be needed to produce 5.4 GW of power Partially tracking solar cell arrays generating 9.4 GW of electricity would require an area of 100 sq km. Computer simulations of the annual rainfall, combined with projections of the variations in wind-solar output, demonstrates that a reserve margin of 1.20 will be necessary. The costs of installation of the renewable energy converters are estimated at about three times that currently necessary for obtaining the same capacity from fission power plants, although the situation may change due to import and technical considerations. M.S.K.

A83-34651

EARTH-ORIENTED SPACE ACTIVITIES AND THEIR LEGAL IMPLICATIONS; PROCEEDINGS OF THE SYMPOSIUM, MCGILL UNIVERSITY, MONTREAL, CANADA, OCTOBER 15, 16, 1981

Symposium supported by the Social Sciences and Humanities Research Council of Canada and McGill University. Montreal, McGill University, 1983, 376 p In English and French

Papers are presented concerning earth-oriented space activities and their legal implications, focusing on the legal problems arising from the practical applications of earth satellites such as environmental observations, connecting different communications systems, and energy transmission Topics examined include whether broadcasting by satellite should be carried out under a regime of free or controlled use, if remote sensing could serve all states, or only those with the appropriate technology; and how energy from space could serve all states, or only those with the appropriate technology, and how energy from space could be utilized and what would be its advantages and disadvantages Also considered is the necessity of delimiting air space and outer space after the advent of aerospace transport established by the U.S. Space Shuttle, by satellite telecommunications, and other activities insensitive to invisible boundaries, which were envisaged by past doctrine, between infinite space and the layer of finite air surrounding the earth N.B.

A83-34659#

ENERGY FROM SPACE - CHANCES AND LIMITATIONS FROM A LEGAL POINT OF VIEW

K.-H. BOECKSTIEGEL (Koeln, Universitaet, Cologne, West Germany) IN: Earth-oriented space activities and their legal implications; Proceedings of the Symposium, Montreal, Canada, October 15, 16, 1981 . Montreal, McGill University, 1983, p 204-219. refs

Legal matters germane to the implementation of solar power satellite systems (SPS) are discussed Noting that the long lead time for the development of SPS technologies will delay their construction until at least into the next century, the benefits of having a year-round nonpolluting energy source are cited. The

construction of the SPS is internationally agreed to be legal as one of the freedoms of sovereign states under the Outer Space Treaty, provided the SPS are used for peaceful purposes. The sanction extends to private activities in space, and the use of moon resources to accomplish the task is suggested to be in no way hindered by the common heritage provision. Liability due to objects falling from space has not, however, been defined by international treaties, although it is the responsibility of the states from which the activities originate to control outer space enterprises. M.S.K.

A83-34660#

SPACE OR TERRESTRIAL ENERGY? (ENERGIE SPATIALE OU ENERGIE TERRESTRE?)

L. BOULET (Hydro-Quebec, Institut de Recherches, Varennes, Canada) IN Earth-oriented space activities and their legal implications, Proceedings of the Symposium, Montreal, Canada, October 15, 16, 1981 . Montreal, McGill University, 1983, p. 220-228. In French.

Consideration is given to the possibility of generating sufficient energy at acceptable costs on earth to offset the need to build solar power satellite systems (SPS). Electricity usage, one of the basic driving forces of developed nations, grows with the population. Currently comprising 33 pct of the total world energy used, electricity is projected to grow to a 50-55 pct share in the 21st century Future terrestrial electrical energy sources include carbon-based fuels, nuclear (fusion or fission), and the renewable solar technologies Carbon-based fuel supplies can last until 2030 AD, about the same as fission plants with recycled fuel Breeder reactors would stretch the nuclear fuels to the year 3000 Solar technologies offer more immediate solutions than fusion reactors and can produce 50 pct of the power available from the construction of the maximum number of nuclear power plants. The addition of SPS would further augment the total Combinations of all the technologies are recommended, with local research for the most appropriate technology for each nation. M.S.K.

A83-35841#

SOME ASPECTS OF DEVELOPMENT OF POWER PLANT OPTIMUM CONTROL TO INCREASE AIRCRAFT FUEL EFFICIENCY

O. K. IUGOV (Gosudarstvennyi Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) IN International Symposium on Air Breathing Engines, 6th, Paris, France, June 6-10, 1983, Symposium Papers . New York, American Institute of Aeronautics and Astronautics, 1983, p. 334-341.

This paper outlines the basic principles for optimum power plant control at different stages of flight The range of flight is taken as an optimization criterion which represents operational effectiveness of the power plant. To solve the problem the methods of optimization are used which are based on the Pontryagin maximum principle and nonlinear programming methods Optimum control laws are implemented by introducing electronic power plant control systems and onboard digital computers. Author

A83-35843*# Analytical Mechanics Associates, Inc., Mountain View, Calif

FLIGHT MANAGEMENT CONCEPTS DEVELOPMENT FOR FUEL CONSERVATION

J. A. SORENSEN (Analytical Mechanics Associates, Inc., Mountain View, CA) and S. A. MORELLO (NASA, Langley Research Center, Flight Management Branch, Hampton, VA) IN. International Symposium on Air Breathing Engines, 6th, Paris, France, June 6-10, 1983, Symposium Papers New York, American Institute of Aeronautics and Astronautics, 1983, p 357-366 refs

It is pointed out that increased airspace congestion will produce increased flight delay unless advanced flight management concepts are developed to compensate. It has been estimated that a 5 percent reduction in delay is approximately equivalent, in terms of direct operating costs, to a 5 percent reduction in drag. The present investigation regarding the development of the required flight management concepts is organized into three sections, related to background, current research, and future effort In the background

section, a summary is provided of past technical effort concerning flight management. The second section is concerned with on-going efforts to integrate flight management with ground-based flight planning, and with an advanced concepts simulator to test the new developments. In the third section, attention is given to research concerning airborne flight management integration with other flight functions G R

A83-36282#**CONCEPTS FOR INCREASED POWER AND ENHANCED FUEL CONSERVATION WITH NEWLY PATENTED MULTIPLE POWER-CYCLE GAS TURBINE ENGINES**

P. K. CORONEL AIAA, SAE, and ASME, Joint Propulsion Conference, 19th, Seattle, WA, June 27-29, 1983. 6 p. (AIAA PAPER 83-1209)

Attention is given to recently patented design innovations aimed at improving the fuel efficiency and power output of axial and centrifugal compressor-equipped gas turbine engines. The systems disclosed integrally incorporate secondary power cycles containing heat absorption systems which convert unpressurized liquids into a pressurized power source, employing the heat energy normally lost through component cooling systems and the engine exhaust. This heat energy is recycled to power a steam turbine, which in turn is employed in increasing the gas turbine's volume of preheated and compressed air. In addition to greater propulsive and fuel efficiencies, a reduction of exhaust heat is envisaged. O.C

A83-36760#**INFRARED OPTICAL PROPERTIES OF A COAL-FIRED POWER PLANT PLUME**

L. P. STEARNS and R. F. PUESCHEL (NOAA, Environmental Research Laboratories, Boulder, CO) Applied Optics (ISSN 0003-6935), vol. 22, June 15, 1983, p. 1856-1860 refs

Infrared measurements in the 8-14-micron spectral region made of two coal-fired power plant (Four Corners and San Juan) plumes and area haze in the Four Corners region of New Mexico from November 1 to November 7, 1980, are discussed. The layer transmittance, optical depth, and volume extinction coefficient derived from measurements on four nonconsecutive days reveal the effects of the plumes in the IR optical properties of the atmosphere. The average contribution of the plume alone to the IR extinction coefficient is 74 percent at the Four Corners plant, the background haze contributes 7-11 percent. More efficient particulate emission control at the San Juan plant reduces the average contribution of its plume to 57 percent of the extinction coefficient. The haze contributes an average of 16 percent. The results reveal an increase with time of the haze bulk extinction coefficient during a persistent anticyclonic synoptic situation. Extinction coefficients of the haze reveal a linearity with particulate loading, which leads to estimates of IR volume extinctions of the free troposphere from aerosol measurements. C.R

A83-37984**DESIGN ASPECTS OF SYSTEMS IN ALL-ELECTRIC AIRCRAFT**

M. J. CRONIN (Lockheed-California Co., Burbank, CA) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 13 p. refs (SAE PAPER 821436)

The advanced technologies relevant to the development of all-electric aircraft are briefly reviewed. In particular, attention is given to the propulsion system, engine starting technology, environmental control systems, avionics, powered wheels, electric brakes, and vortex turbine generators. The results of several technology studies are reported which illustrate the potential of all-electric aircraft for yielding very attractive fuel-savings and aircraft support/acquisition cost reductions. V.L.

A83-37989**THE RECIPE FOR RE-ENGINEING JET TRANSPORTS**

L. B. ASCHENBECK (Cammacorp, El Segundo, CA) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 13 p. refs (SAE PAPER 821441)

The relative newness of the DC-8-60's plus their advanced aerodynamic and structural technology combined with the CFM56-2 high by-pass engine results in a modern, economic aircraft. FAR Part 36 Noise Requirements and the prospect of ever increasing fuel costs make the retrofit DC-8-60's a prudent investment. The type certificate for these re-engined aircraft will designate them at DC-8-70's. Performance improvements, noise reduction and reduced fuel consumption provide distinct and quantifiable benefits to the operators of the DC-8-70's. These benefits are verified by the results of certification flight testing and will be presented in detail. Author

A83-37991**727, B-52 RETROFIT WITH PW2037 MEETING TODAY'S REQUIREMENTS**

R. ALTMAN (United Technologies Corp., Commercial Products Div., East Hartford, CT) and E. P. FLYNN (United Technologies Corp., Government Products Div., West Palm Beach, FL) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 13 p. (SAE PAPER 821443)

The suitability of 727 and B-52 PW2037 powerplant retrofit options are examined. The potential PW2037 gains over JT8D, TF33, and J57 in cycling and component technology are identified, and engine installation and aircraft modification tasks for the 727 and B-52 are addressed. Adjustments in the nacelle, cases, plumbing, and aircraft system interface of the 727 that will be needed for installing the PW2037 are described, and resulting improvements in range, fuel economy, and noise are stated. Reengining in the B-52 is discussed, including the resulting benefits for maritime missions and conventional bombing. B-52 engine modifications required for high altitude operations of the PW2037 are given. C.D.

A83-37999* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

OPTIMAL TURNING CLIMB-OUT AND DESCENT OF COMMERCIAL JET AIRCRAFT

F. NEUMAN and E. KREINDLER (NASA, Ames Research Center, Moffett Field, CA) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 12 p. refs (SAE PAPER 821468)

Optimal turning climb-out and descent flight-paths from and to runway headings are derived to provide the missing elements of a complete flight-path optimization for minimum fuel consumption. The paths are derived by generating a field of extremals, using the necessary conditions of optimal control. Results show that the speed profiles for straight and turning flight are essentially identical, except for the final horizontal accelerating or decelerating turn. The optimal turns, which require no abrupt maneuvers, could easily be integrated with present climb-cruise-descent fuel-optimization algorithms. Author

A83-38655*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PARAMETRIC STUDY OF FACTORS AFFECTING THE FUEL EFFICIENCY OF ADVANCED TURBOPROP AIRPLANES

V. S. JOHNSON (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics, Applied Aerodynamics Conference, Danvers, MA, July 13-15, 1983. 9 p. refs (AIAA PAPER 83-1823)

Results of a parametric study to determine the effects of design variables and penalties on the fuel efficiency of Mach 0.8, 125-passenger, advanced turboprop airplanes show that propeller-wing interference penalty has a major effect. Propeller

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tip speed has a minor effect, and could be decreased to alleviate the noise problem without significant effects on fuel efficiency. The anticipated noise levels produced by the propfan will require additional acoustical treatment for the fuselage; this additional weight can have a significant effect on fuel efficiency. The propfan advantage over an equivalent technology turbofan is strongly dependent on the interference penalty and acoustical treatment weight. Lowering the cruise Mach number to around 0.73 would result in greatly increased fuel efficiency. Author

A83-38760

METEOROLOGICAL DATA REQUIREMENTS FOR FUEL EFFICIENT FLIGHT

H. C. TRUE and D. E. WINER (FAA, Washington, DC) IN: Conference on Aerospace and Aeronautical Meteorology, 9th, Omaha, NE, June 6-9, 1983, Preprints Boston, MA, American Meteorological Society, 1983, p. 293-298. refs

Development in flight management systems and automated air traffic control are discussed. Attention is also given to the meteorological data required by these systems and to the way in which they depend on this data. Radiosondes, satellites, and systems for automated pilot reporting are discussed and compared. The systems capable of meeting aviation requirements in the 1990s are described. It is pointed out that automated air traffic control and flight management will provide potential fuel savings only if accurate, complete, and timely meteorological data are available. Better upper wind and temperature data for flight planning could save one to three percent of domestic commercial aviation fuel, or 100 to 300 millions gallons each year. An advanced automated air traffic control system taking advantage of accurate and timely weather information would save at least three percent of commercial aviation fuel. C.R.

A83-38875

ECONOMIC EVALUATION OF A STANDARD PRODUCT OF FIBER-REINFORCED COMPOSITE MATERIAL IN COMPARISON WITH STEEL [WIRTSCHAFTLICHKEITSBETRACHTUNG FUER EIN STANDARDPRODUKT AUS FASERVERBUNDWERKSTOFF IM VERGLEICH ZU STAHL]

H. FLECKENSTEIN (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) VDI-Z (ISSN 0042-1766), vol. 125, Feb. 1983, p. 123-131 In German. refs

The total-lifetime energy cost of a standard product made of steel (density 7.8 g/cu cm) is compared with that of the same product made with a reinforced composite material (42 pct glass fiber, 18 pct carbon fiber, 40 pct resin; density 2.0 g/cu cm). Tables and figures illustrate the properties, composition, manufacture, and application of different reinforced composites. The energy-equivalence calculations are based on four phases in the life of the standard product: (A) production of the semifinished stock from the raw materials, (B) manufacture of the product, (C) use of the product (carburetor-engine-powered operation at 20,000 km/year for a life of 10 years), and (D) recovery/recycling of the material after use. The step-by-step results of the analysis are presented in tables for each material. The net energy costs (A + B - D) of the product (which weighted 1000 kg in steel and 600 kg in composite) were 33,100 kW for steel and 1,366 kW for composite; the costs of use (C) were 210,000 kW for steel and 126,000 kW for composite, reflecting the weight difference. T.K.

A83-39220

THE EMPLOYMENT OF A MINIATURE CALCULATING DEVICE FOR THE DETERMINATION OF THE CENTER OF GRAVITY [EINSATZ EINES KLEINSTRECHNERS ZUR SCHWERPUNKTBERECHNUNG]

M. CASPARI and B. GLOECKNER (Interflug Gesellschaft fuer internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 18, no. 6, 1982, p. 212-214. In German.

Small electronic calculators are increasingly used in many areas of the national economy because they provide a convenient approach for obtaining rapidly accurate solutions in the case of many computational problems. A description is presented of an

example for such an employment of a calculator, taking into account the use of a programmable calculator for the determination of optimal loading conditions and the calculation of the center of gravity in the case of the aircraft IL-62/IL-62M. The position of the center of gravity of the loaded aircraft has an effect on fuel consumption. The use of the programmable calculator makes it possible to determine conveniently optimal loading conditions with respect to fuel consumption. Magnetic cards are used for introducing programming data and for recording data. It has been found that, after a brief introduction, a pilot can work very reliably with the calculator and the program. G.R.

N83-23332# Associated Architects of Crested Butte, Colo.

GUNNISON COUNTY AIRPORT TERMINAL Final Report

L. H. WALLER and J. F. KREIDER (Kreider (Jan F.) and Associates, Inc.) 30 Nov. 1982 129 p refs

(Contract DE-FC02-80CS-30339; PROJ. 339)

(DE83-004512; DOE/CS-30339/T1) Avail: NTIS HC A07/MF A01

The Gunnison Airport includes a number of solar and energy conservation features: south reflective surface for improved winter solar gain, Trombe wall, night setback, summer vent system, clerestory, high heat recovery ducts, task lighting, high levels of wall insulation, direct gain system and slab storage, operable windows, and airlock entries. After a summary of weather data collected in Gunnison, Colorado, the building performance is presented. The nature and magnitude of all connected loads at the airport are described, and the magnitude of solar contribution is evaluated and discussed using measured weather data. Performance prediction methods used during design are evaluated relative to their accuracy. Owner's and designers perspectives are presented, and information dissemination efforts are described. DOE

N83-23490# Oak Ridge Gaseous Diffusion Plant, Tenn.

LARGE CLIMATE-MODERATING ENVELOPES FOR ENCLOSED STRUCTURES: A PRELIMINARY EVALUATION OF ENERGY-CONSERVATION POTENTIAL

G. E. GILES, J. E. PARK, and R. L. WENDT 1982 24 p refs Presented at the ASME Winter Ann. Meeting, Phoenix, Ariz., 14-19 Nov. 1982

(Contract W-7405-ENG-26)

(DE82-012817; K/CSD/INF-82-6; CONF-821101-1) Avail: NTIS HC A02/MF A01

A preliminary estimate is given of the energy conservation benefits of a large climate moderating envelope (LCME). A hypothetical LCME design was chosen and a coupled fluid dynamic and energy transport analysis was performed to estimate the energy conservation potential of this design. The heat transfer models included insolation, outside air temperature and wind, thermal radiation exchange with the sky, thermal radiation exchange between the fabric and ground, and thermal storage in the earth mass beneath the LCME. The energy transported within the fluid by the buoyancy driven circulation was modeled as an incompressible fluid utilizing the Boussinesq approximation. The climatic conditions were assumed to vary in smooth, repeating daily cycles. The numerical simulation of climatic variation was continued until the results within the LCME achieved a repeating daily cycle. The results for selected seasonally characteristic days were utilized to estimate the annual energy consumption of structures within an LCME relative to similar structures exposed to the exterior. DOE

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N83-23491# Oak Ridge Gaseous Diffusion Plant, Tenn. Computer Sciences Dept.

LARGE CLIMATE-MODERATING ENVELOPES FOR ENCLOSED STRUCTURES: A PRELIMINARY EVALUATION OF ENERGY-CONSERVATION POTENTIAL

G. E. GILES, J. E. PARK, and R. L. WENDT Jun. 1982 9 p refs Presented at the ASME 1982 Winter Ann Meeting, Phoenix, Ariz., 14-19 Nov 1982

(Contract W-7405-ENG-26)

(DE82-018350, K/CSD/INF-82/6-RI, CONF-821101-1-REV-1)

Avail: NTIS HC A02/MF A01

One method of reducing the energy consumption of one or more buildings is to isolate the buildings within a large envelope. The envelope moderates the effects of Sun, wind and precipitation and provides a more benign climate for habitation, commerce and, in some climates, agricultural activities. Results of a preliminary study of the qualitative energy conservation benefits are given for a large climate moderating envelope (LCME). The effects of weather, fluid circulation and radiant transport within the envelope and energy storage in the mass beneath the LCME are included. Based on model studies for selected days, the annual energy savings for summer dominated climates was estimated to be approximately 70%. The energy savings for a winter dominated climate LCME were estimated to be somewhat smaller, approximately 40%. DOE

N83-23697*# Critical Fluid Systems, Inc., Cambridge, Mass. **ASSESSMENT OF CRITICAL-FLUID EXTRACTIONS IN THE PROCESS INDUSTRIES Final Report**

Apr. 1982 40 p refs

(Contract JPL-956159, DE-A(01-81CS-66001)

(NASA-CR-170243, JPL-9950-793, NAS 1 26 170243) Avail:

NTIS HC A03/MF A01 CSCL 10A

The potential for critical-fluid extraction as a separation process for improving the productive use of energy in the process industries is assessed. Critical-fluid extraction involves the use of fluids, normally gaseous at ambient conditions, as extraction solvents at temperatures and pressures around the critical point. Equilibrium and kinetic properties in this regime are very favorable for solvent applications, and generally allow major reductions in the energy requirements for separating and purifying chemical component of a mixture. Author

N83-23715# Committee on Energy and Natural Resources (U.S. Senate).

FINAL 5-YEAR PLAN FOR OIL AND GAS DEVELOPMENT IN THE OUTER CONTINENTAL SHELF

Washington GPO 1982 193 p refs Hearing before the Subcomm on Energy Conserv. and Supply of the Comm. on Energy and Natural Resources, 97th Congr., 2d Sess., 8 Sep 1982

(GPO-11-566) Avail: Subcommittee on Energy Conservation and Supply

The five year plan for oil and gas development in the outer continental shelf was discussed, considering such aspects as protecting marine, coastal, and human environments, as well as, our energy needs. B G.

N83-23716# Committee on Energy and Natural Resources (U.S. Senate)

FEDERAL POWER ACT AMENDMENTS OF 1982

Washington GPO 1982 120 p Hearing on S 2500 before the Subcomm on Energy Regulation of the Comm on Energy and Natural Resources, 97th Congr., 2d Sess., 22 Jul. 1982

(GPO-09-140) Avail: Subcommittee on Energy Regulation

Testimony on a bill to amend the hydroelectric licensing provisions of the Federal Power Act is presented. Author

N83-23717# Committee on Energy and Natural Resources (U.S. Senate).

ENERGY INITIATIVES OF THE 96TH CONGRESS

Jun. 1982 255 p refs Rept presented by the Comm on Energy and Nat. Resources, 97th Congr., 2d Sess., Jun. 1982 (PUBL-97-73; GPO-94-897) Avail: Committee on Energy and Natural Resources

The Energy Security Act of 1980 is discussed. Fossil fuels energy policy, nuclear power issues, solar and renewable energy research and development, energy conservation programs, and organizational policy are also discussed. Author

N83-23718# Committee on Energy and Natural Resources (U.S. Senate).

US PARTICIPATION IN THE INTERNATIONAL ENERGY PROGRAM

Washington GPO 1982 87 p refs Hearing on S 1937 before the Comm. on Energy and Natural Resources, 97th Congr., 2d Sess., 4 Feb 1982

(GPO-95-065) Avail: Committee on Energy and Natural Resources

Issues relating to the international energy program, including issues concerning U.S. participation are considered. Extending participation of U.S. oil companies in the international energy program is also considered. Author

N83-23721# Department of Energy, Washington, D. C. Office of Assistant Secretary for Conservation and Renewable Energy.

APPLICATIONS STUDY FOR WIND ENERGY SYSTEMS AT FEDERAL FACILITIES Final Report

Sep. 1981 101 p refs

(DE82-007929, DOE/NBM-1004-VOL-2) Avail. NTIS HC A06/MF A01

An assessment of the possible applications for wind systems in the Federal sector is presented. The technical and nontechnical issues which need to be addressed in planning for economic competitiveness with the marginal costs of conventional energy sources in the respective areas are identified. S L

N83-23735# Rockwell International Corp., Golden, Colo. Energy Systems Group.

RESIDENTIAL CONSERVATION SERVICE

J. M. SHERMAN /in Midwest Research Inst Proc. Small Wind Turbine Systems, 1981 p 219-228 1981

Avail: NTIS HC A19/MF A01

The Residential Conservation Services Program is a result of the 1978 National Energy Conservation Policy Act, Public Law 95-619 passed by congress to address the need for energy conservation in the residential sector. Large utility companies and fuel suppliers will be offering audits of their customers' homes to relay technical and economic data about conservation, solar, and wind measures. The impact on utility companies as a result of this program is to offer low cost audits (\$15.00 charge for an audit costing approximately \$100.00) and to assist their customers in reducing their consumption of electricity, gas, and oil through the use of conservation and renewables. The impact of RCS on wind turbine manufacturers and dealers is an opportunity to participate in a program which provides potential customers. Author

N83-23736# Rockwell International Corp., Golden, Colo. Energy Systems Group

FIELD EVALUATION PROGRAM

J. L. PASTORE /in Midwest Research Inst Proc. Small Wind Turbine Systems, 1981 p 229-236 1981

Avail. NTIS HC A19/MF A01

As public interest in alternative energy sources increased, the importance of small wind systems was recognized by the Department of Energy (DOE). Small Wind Energy Conversion Systems (SWECS) connected to an electric utility system offers a good potential for a cost effective use of this energy alternative. DOE initiated a number of programs designed to accelerate the commercialization of wind systems. The Field Evaluation Program

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has been designed as a part of the federal wind program to accelerate the commercialization process for SWECS. The program goal is to provide near-term resolution of existing technical and institutional constraints in order that wind energy can have the maximum impact on the nation's energy needs. Stimulation of various segments of the SWECS industry will also be a benefit of the program. Author

N83-23740# Northeast Solar Energy Center, Boston, Mass.
THE WIND PROGRAM AT THE NORTHEAST SOLAR ENERGY CENTER

R. L. BISPLINGHOFF /In Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 301-305 1981
Avail: NTIS HC A19/MF A01

The Northeast Solar Energy Center, established in 1977, is one of four regional centers created by the Department of Energy to encourage the use of solar technologies to help meet the nation's energy needs. To this end, the Center's staff works closely with state and local governments, community groups, industry, utilities, contractors, architects, engineers, educators and the legal, financial and insurance communities. The nine states (New York, New Jersey, Pennsylvania, and New England) served by NESEC participate directly in its activities through two gubernatorial designees for each state. Also, NESEC funds two solar professionals in each state energy office who form NESEC's Regional Information Network. Author

N83-23741# Western Sun, Portland, Oreg
REGIONAL SOLAR ENERGY CENTER OVERVIEW: WESTERN SUN

M. G. EDDS /In Midwest Research Inst. Proc. Small Wind Turbine Systems, 1981 p 307-320 1981
Avail: NTIS HC A19/MF A01

This paper presents an overview of Western SUN, its general program areas, and specific wind energy projects for fiscal year 1981. Also included is a brief discussion of an important Federal Act that will impact the future electric energy supply of the Northwest; the Pacific Northwest Electric Power, Planning and Conservation Act (1980). Author

N83-23742# Service de la Programmation de la Politique Scientifique, Brussels (Belgium).

NATIONAL RESEARCH AND DEVELOPMENT PROGRAM IN THE ENERGY FIELD Annual Report [PROGRAMME NATIONAL DE R-D DANS LE DOMAINE DE L'ENERGIE]

24 Jun. 1982 76 p /In FRENCH
(PNP/ENE/82/3) Avail: NTIS HC A05/MF A01

Scientific, technological, and economic criteria were established to clarify, in a total context, the choices open to Belgium in meeting the energy crisis and in reducing dependence on foreign sources of fuels and strategic materials. Mathematical models were developed to describe the energy supply and demand in both the industrial and residential sectors. For the period from 1982 to 1987, activities concentrate on analyzing the energy system, determining reasonable use of energy in all sectors, investigating fossil energy and the energetic vectors of substitution and biomass; automating processes for the production of solar cells and the development solar receivers and photovoltaic systems, and recycling and stockpiling strategic materials. A documentation center was established to evaluate national and international research results. Transl by A.R.H.

N83-23751# Technische Univ., Graz (Austria). Inst fuer Waermetechnik
HEAT PUMPS

P. V. GILLI /In ESA Solar Energy 1982. Resources, Technol., Potential p 47-52 Nov. 1982 refs
Avail: NTIS HC A12/MF A01

Heat pumps for residential/commercial space heating and hot tap water make use of free energy of direct or indirect solar heat and save from about 40 to about 70 percent of energy if compared to a conventional heating system with the same energy basis. In addition, the electrically driven compressor heat pump is able to

substitute between 40% (bivalent alternative operation) to 100% (monovalent operation) of the fuel oil of an oilfired heating furnace. For average Central European conditions, solar space heating systems with high solar coverage factor show the following sequence of increasing cost effectiveness: pure solar systems (without heat pumps), heat pump assisted solar systems; solar assisted heat pump systems, subsoil/water heat pumps; air/water heat pumps; air/air heat pumps. Author

N83-23777# Gesellschaft fuer Industriewaerme und Verfahrenstechnik m.b.H., Krefeld (West Germany)
RECUPERATION OF WASTE HEAT FROM FLUE GASES CONTAINING SOLID PARTICLES AND CORROSIVE CHEMICALS AT HIGH TEMPERATURES Final Report, May 1981

U. TRAPPE Bonn Bundesministerium fuer Forschung und Technologie Nov. 1982 127 p refs /In GERMAN, ENGLISH summary
(BMFT-FB-T-82-195, ISSN-0340-7608) Avail: NTIS HC A07/MF A01, Fachinformationszentrum, Karlsruhe, West Ger DM 26,50

Heat recuperation which is the heating up of combustion air by the heat of flue gases were examined. The research project included: development of the mathematical models and computer programs for complete systems of cassette recuperators, practical trials and measuring of performance data of a cassette recuperator installed at two soaking pit chambers long term test to determination of life expectancy. It is found that cassette recuperators have under comparable conditions a life time of three years and are more economical than convective recuperators. Protective layers on the heat resisting sheets, promise a rise of durability of 50 to 100%. Cassette recuperators are installed at approx 20 soaking pit chambers in the steel industry. E.A.K.

N83-23788# Arbeitsgemeinschaft Plenar Niedertemperatur-Waermeverbund G.m.b.H., Frankfurt (West Germany).

LOW TEMPERATURE INDUSTRIAL WASTE HEAT UTILISATION IN THE AREA. SPEYER-LUDWIG-SHAFEN-FRANKENTHAL-WORMS Final Report, Jul. 1981

K. NUNOLD and A. KREBS Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 311 p refs /In GERMAN; ENGLISH summary Original contains color illustrations
(BMFT-FB-T-82-215, ISSN-0340-7608) Avail: NTIS HC A14/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 48

The economical conditions utilize low temperature industrial waste heat systems for heating purposes were examined. Waste heat are provided by power and industrial plants. A number of application possibilities for heat pumps are shown and it is evident that there is a high variation of the heat requirement due to social components and the different type of building structures. The economic results show that the application of this heating system can supplement or replace other heating systems. E.A.K.

N83-23789# Scheven Ingenieure G.m.b.H., Duesseldorf (West Germany). Planungsgesellschaft fuer Wasser- und Abfallwirtschaft mbH.

STUDY FOR HEAT RECOVERY FROM WASTE WATER AND UTILIZATION POSSIBILITIES ILLUSTRATED BY USING THE EXAMPLE OF THE CITY OF LEMGO Final Report, Nov. 1981

M. GASSEN and D. HUNKE Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 95 p refs /In GERMAN; ENGLISH summary
(BMFT-FB-T-82-235; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 20

The amount of heat contained in municipal waste water and the possibilities of recovering it were investigated. The effects of heat removal on the waste water treatment efficiency was discussed. The basic condition for the conceived process is that the heat is directly removed, i.e., without special conditioning, and brought to an adequate temperature level for use in the heat supply system via the heat pumps. Various possibilities for the

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use of heat contained in waste water were studied. The savings of primary energy is considerable compared with conventional heating systems. Nevertheless, the feasibility study carried out shows no savings in yearly costs as compared with conventional heating systems. S.L.

N83-23808# TRW, Inc., McLean, Va Energy Engineering Div.
CHEMICAL HEAT PUMP COST EFFECTIVENESS EVALUATION
W. R. STANDLEY /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 49-54 Mar 1982 refs

Avail: NTIS HC A11/MF A01

The cost effectiveness and energy effectiveness of existing chemical heat pump (CHP) concepts are compared with a baseline of conventional energy technologies and a group of near term emerging energy technologies with which CHPs are expected to compete. The analysis is structured to evaluate these systems functioning as the primary space conditioning unit of both a 'standard' single family detached home and a 'representative' commercial building. Each HVAC system and application is analyzed in each of two locations. In addition, the CHPs are evaluated in a 'representative' industrial waste heat upgrading application, and compared to potentially competitive technologies for industrial 'heat pumping' S.L.

N83-23814# Westinghouse Electric Corp., Pittsburgh, Pa
DEVELOPMENT AND DEMONSTRATION OF AN ELECTRIC HEAT PUMP FOR WASTE HEAT RECOVERY IN INDUSTRY
W. C MORELAND /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 85-88 Mar. 1982 refs

(Contract DE-AC01-77CS-40327)

Avail: NTIS HC A11/MF A01

The technical feasibility and economic viability of using heating pumps to reclaim low temperature waste heat energy from industrial processes was demonstrated. Delivery temperatures of 250 to 350 F, source temperatures of 180 to 250 F, coefficients of performance of 3 or greater, and paybacks of four years or less are expected S.L.

N83-23816# General Electric Co., Schenectady, N. Y Corporate Research and Development Dept
OPEN CYCLE HEAT PUMP FOR INDUSTRIAL WASTE HEAT UTILIZATION

C. R SNYDER /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 96-97 Mar 1982

Avail: NTIS HC A11/MF A01

The open cycle industrial process heat pump technology is a cost-effective method of utilizing an industrial plant's waste heat. Three sites and four process configurations were evaluated. The basis for the initial screening provided opportunities to exploit the features of the open cycle arrangement. Site visits yielded process information on flow rates, process temperatures, pressures, dynamic behavior, energy balances, control functions and plant operating philosophy. Additional information was obtained relating to plant utilities and equipment location. Comparative evaluations were made considering energy savings, cost savings, value of operating experience and the potential for wide application. S.L.

N83-23819# Energy Utilization Systems, Inc., Pittsburgh, Pa
DEMONSTRATION OF A HEAT PUMP WATER HEATER
R. P. BLEVINS /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 105-107 Mar 1982 refs

Avail: NTIS HC A11/MF A01

In the period between March 1979 and January 1980, 85 prototype heat pump water heaters were installed in single-family residences. Each system was monitored for a period of one year and total program monitoring was concluded at the end of December 1980. The field demonstration provided a total of 643 unit-months of usable operational data which showed an average OOP of 1.93, or an average 48% operating savings compared to resistance water heating. Average operating conditions were 73 gallons of 140 F water consumed each day with an average inlet

water temperature of 71 F. Despite a high initial failure rate for the prototypes, which resulted in a protracted debugging period, consumer reaction to the system was extremely positive. The data suggests that the HPWH would save the average consumer in the test program 2917 kWh per year. Measurable impacts on heating/cooling systems were detected in only 8% of the test homes Author

N83-23828# Argonne National Lab., Ill.
THE DOE HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS PROJECT

J. M CALM /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 185-192 Mar. 1982 refs
(Contract W-31-109-ENG-38)

Avail: NTIS HC A11/MF A01

The Heat-Pump-Centered Integrated Community Energy Systems Project seeks to conserve energy by developing heat pump systems for district heating and cooling. Seven contractor teams were involved in concept development and subsequent application feasibility studies. A technical and economic assessment of the systems developed was performed based on the results of these and two related studies. The assessment concludes that district heating and cooling with heat pumps can conserve energy resources, and particularly nonrenewable fuels, in an environmentally and economically attractive way. The application potential is believed to be broad, and the energy savings of widespread implementation would be substantial. No one system is universally applicable, but many options exist. Market forces are already promoting many of the required technologies, but further research, development, and demonstration could accelerate implementation Author

N83-23863# Los Alamos Scientific Lab., N. Mex.
THE DEPARTMENT OF DEFENSE ENERGY VULNERABILITIES: POTENTIAL PROBLEMS AND OBSERVATIONS

D. A. FREIWALD, M. E. BERGER, and J. F. ROACH Aug 1982 52 p refs

(Contract W-7405-ENG-36)

(DE82-021140; LA-9485-MS) Avail: NTIS HC A04/MF A01

The Department of Defense is almost entirely dependent on civilian energy supplies to meet its needs in both peacetime and periods of heightened conflict. There are a number of potential vulnerabilities to the continual and timely supply of energy to both the civilian and military sectors. These include denial of the energy resources themselves, disruption of critical transportation networks, destruction of storage facilities, and interruption of electrical power. This report briefly reviews the present situation for provision of energy from the civilian sector to the military. General vulnerabilities of the existing energy supply system are identified, along with the potential for armed aggression (including terrorist and sabotage activities) against the energy network. Conclusions and some tentative observations are made as to a proper response to the existing vulnerabilities. DOE

N83-23864# Technical Information Center, Oak Ridge, Tenn
ENERGYGRAMS: BRIEF DESCRIPTIONS OF ENERGY TECHNOLOGY

W. F. SIMPSON, JR., ed. 1982 95 p refs

(DE82-003279, DOE/TIC/EGC-82/2) Avail: NTIS HC A05/MF A01

Energygrams: Brief Descriptions of Energy Technology, is a compilation of technical notes (called Energygrams) published by the Technical Information Center. The Center instituted the Energygram program to help fulfill a mission of the US Department of Energy (DOE) to transfer information and technology generated from DOE-sponsored research to identifiable audiences in industry, education, and federal, state, and local government. The Technical Information Center routinely screens all DOE R and D reports to identify appropriate information. It also coordinates with DOE and DOE laboratory and contractor program managers in identifying research and development projects for the transfer program and in reviewing the technical content of Energygrams before publications. Energygrams are usually one-page illustrated bulletins

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describing DOE technology or data and telling how to obtain the technical reports or other material on which they are based

DOE

N83-23870# Illinois Inst of Tech, Chicago Dept of Mechanical Engineering
FEASIBILITY OF A MEDIUM-SIZE CENTRAL COGENERATED ENERGY FACILITY, ENERGY MANAGEMENT MEMORANDUM
R W PORTER Sep. 1982 35 p refs
(Contract DE-FG02-80CS-40337)
(DE83-005084; DOE/CS-40337/7; TN-82-7) Avail. NTIS HC A03/MF A01

The thermal-economic feasibility was studied of a medium-size central cogenerated energy facility designed to serve five varied industries. Generation options included one dual-fuel diesel and one gas turbine, both with waste heat boilers, and five fired boilers. Fuels included natural gas, and for the fired-boiler cases, also low-sulphur coal and municipal refuse. The fired-boiler cogeneration systems employed back-pressure steam turbines. For coal and refuse, the option of steam only without cogeneration was also assessed. The refuse-fired cases utilized modular incinerators. The options provided for a wide range of steam and electrical capacities. Deficient steam was assumed generated independently in existing equipment. Excess electrical power over that which could be displaced was assumed sold to Commonwealth Edison Company under PURPA (Public Utility Regulator Policies Act). The facility was assumed operated by a mutually owned corporation formed by the cogenerated power users. The economic analysis was predicted on currently applicable energy-investment tax credits and accelerated depreciation for a January 1985 startup date. Based on 100% equity financing, the results indicated that the best alternative was the modular-incinerator cogeneration system.

DOE

N83-23921# California Univ, Berkeley Lawrence Berkeley Lab. Energy and Environment Div
MONITORED LOW-ENERGY HOUSES IN NORTH AMERICA AND EUROPE: A COMPILATION AND ECONOMIC ANALYSIS
J C RIBOT and A H ROSENFELD Aug 1982 21 p refs
Presented at the 2nd ACEEE Conf on Energy Efficient Buildings, Santa Cruz, Calif., 22 Aug 1982
(Contract DE-AC03-76SF-00098)
(DE82-021789, LBL-14788, CONF-820849-8) Avail. NTIS HC A02/MF A01

In a continuing compilation, 128 submetered, energy efficient homes in North America and Europe were analyzed. Only 59 have acceptable data on additional first cost of conservation measures. Of these, the lowest cost of conserved energy is for the superinsulated category, where the cost of conserved energy is well under the average price of electricity, i.e., 6.2 cents per kWh. Only 37 homes have submetering adequate to permit correcting space heating loads for variations in occupant behavior (thermostat setting and internal gains). For these 37, the mean standardized thermal integrity is 50.3 kJ per sq meter DD, compared to US 1979 building practice of 100, or US stock of 180.

DOE

N83-23936# Allen (Eliot) and Associates, Inc., Salem, Oreg
INSTITUTIONAL AND FINANCIAL GUIDE TO GEOTHERMAL DISTRICT HEATING, SERIAL NO. 2
Mar 1982 29 p refs
(Contract DE-FG51-79RO-00079)
(DE82-020567, WAOENG-82-03) Avail. NTIS HC A03/MF A01

General planning considerations which affect nearly every community are reviewed, and alternative operating structures which are available to communities are reviewed, including local governments, nonprofit cooperatives, private enterprises, and joint ventures. The financing options available to publicly-owned and privately-owned district heating systems are then summarized. The geothermal production and distribution activities most appropriate to each type of operating structure are reviewed, along with typical equity and debt funding sources. The tax advantages for private developers are described, as are the issues of customer contracts

and service prices, and customer retrofit financing. The treatment is limited to an introductory overview

DOE

N83-23962# Los Alamos Scientific Lab, N. Mex
ECONOMIC AND REGULATORY EFFICIENCY IN AIR-POLLUTION CONTROL Ph.D. Thesis - Stanford Univ.
C D KOLSTAD Jul 1982 258 p refs
(Contract W-7405-ENG-36)
(DE82-021149; LA-9458-T) Avail. NTIS HC A12/MF A01

This dissertation provides a bridge between oversimplified analyses of regulatory alternatives and undersimplified perceptions of the air pollution problems by regulators. Some of the more critical realistic aspects of air pollution such as time-varying pollutant transport, locational aspects of pollution control, demand for goods jointly produced with pollution, and uncertainty are discussed. Optimal levels and distribution of pollution as well as the efficiency of alternate regulatory structures in achieving optimality are explored.

DOE

N83-23963# Colorado Univ, Denver Center for Environmental Sciences.

OIL SHALE ENVIRONMENTAL RESEARCH AND COORDINATION Progress Report, 1981 - 1982

W R CHAPPELL 1982 351 p refs
(Contract DE-AC02-79EV-10298)
(DE82-020762, DOE/EV-10298/4) Avail. NTIS HC A16/MF A01

The environmental impacts of an oil shale industry and strategies to mitigate these effects are discussed. A comprehensive study of the sources, release mechanisms, transport, fate, and effects of toxic trace substances, principally the trace elements, in an oil shale industry was done. The coordination and research management of the program are discussed.

DOE

N83-23965# Hoffman-Holt, Inc., Silver Spring, Md
THE EFFECT OF COAL CLEANING ON THE QUANTITY OF SULFUR DIOXIDE AND ASH PRODUCED BY COAL-FIRED POWER GENERATION IN THE NORTHEASTERN UNITED STATES

R. M JONES and M V JONES 15 May 1982 141 p refs
(Contract DE-AC01-75ET-12512)
(DE82-016060, DOE/ET-12512/2) Avail. NTIS HC A07/MF A01

The extent to which coal cleaning could reduce sulfur dioxide and ash output by Northeastern utilities is estimated. Total permissible SO₂ release was calculated for each state and the entire region based upon applicable environmental regulations. These results were compared with SO₂ outputs corresponding to the compositions of the coals reported by the utilities and the compositions of cleaned coals derived from laboratory data. The results indicated that the assumed fine coal physical cleaning methods could reduce total SO₂ output by as much as 42% (as compared to reported coal compositions) and that advanced chemical cleaning technologies could achieve potential reductions of approximately 90%. Corresponding reductions were determined for ash wastes: the reported coals could be expected to produce about 14 million tons of ash, physically cleaned coals about 4 million tons, and advanced chemically cleaned coals approximately 1.3 million tons.

DOE

N83-23970# Interagency Task Force on Acid Precipitation, Washington, D.C.

NATIONAL ACID PRECIPITATION ASSESSMENT PLAN

Jun. 1982 101 p refs
(DE83-002939, DOE/NBM-3002939) Avail. NTIS HC A06/MF A01

The Plan on acid precipitation assessment has five parts. The authorizing legislation and the organization of the Plan itself are described. Previous federal planning efforts in the current acid rain research programs are discussed. In part a general overview of current understanding of the phenomenon and consequences of acid rain is presented. Subjects discussed include evidence of trends in rainfall acidity, possible sources of acid precipitation; atmospheric chemistry and transport; monitoring of acid deposition;

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the effects of acid precipitation, the relationship of acid precipitation to human health; and control technologies and mitigation of impacts. Nine categories of information needed to enhance our ability to make sound energy, environmental, economic, and resource policy decisions are identified: (1) natural sources; (2) man made sources; (3) atmospheric processes; (4) deposition monitoring; (5) aquatic impacts; (6) terrestrial impacts; (7) effects on materials and cultural resources; (8) control technologies; and (9) assessment and policy analysis. Possible indirect effects on human health are addressed in both categories (5) and (6). The research proposed to address these information needs and the management and coordination of the program are described.

DOE

N83-23972# California Univ., Los Angeles Dept. of Earth and Space Sciences.

PETROLEUM HYDROCARBONS IN STORMWATER RUNOFF AND MUNICIPAL WASTES: INPUT TO COASTAL WATERS AND FATE IN MARINE SEDIMENTS

R. P. EGANHOUSE, D. L. BLUMFIELD, and I. R. KAPLAN 1982 35 p refs. Presented at the 7th Intern. Symp. Chem. of the Mediterranean Transport and Reactivity of Pollutants in the Estuary, Primosten, Yugoslavia, 6-12 May 1982. (Contract DE-AT03-76EV-70134)

(DE83-001318; CONF-8205127-1) Avail. NTIS HC A03/MF A01

Urban stormwaters, municipal wastes and waste-affected ocean sediments were sampled and then analyzed for their hydrocarbon content and composition. The hydrocarbon concentrations in runoff are highly variable ranging from 1 to 20 mg per liter and making up approximately 60% of the total extractable organic matter. Wastewater hydrocarbon concentrations are of similar magnitude (5 to 23 mg per liter). However, the temporal variability is much lower. Estimates for the mass emission rates of runoff and wastewater hydrocarbons to the ocean in southern California are 9700 and 17,400 metric tons per year, respectively. Thus, municipal effluents contribute almost twice the amount of oil to coastal waters as does rainfall runoff in this region. Compositionally, the hydrocarbons in both sources resemble a mixture of various petroleum products, biogenic components being, at most, minor constituents.

DOE

N83-23973# Oak Ridge National Lab., Tenn. Environmental Sciences Div.

PREPARATION OF ENVIRONMENTAL ANALYSES FOR SYN-FUEL AND UNCONVENTIONAL GAS TECHNOLOGIES

R. M. REED, ed. Sep. 1982 210 p refs

(Contract W-7405-ENG-26)

(DE83-001718, ORNL-5911; PUBL-1843) Avail. NTIS HC A10/MF A01

Potentially significant environmental issues associated with a selection of syn-fuel technologies are discussed and guidance is given for developing information and preparing analyses to address these issues. The technologies considered are western oil shale, tar sand, coal liquefaction and gasification, peat unconventional gas (western tight gas sands, eastern Devonian gas shales, methane from coal seams, and methane from geopressured aquifers), and fuel ethanol. Potentially significant issues are discussed under the general categories of land use, air quality, water use, water quality, biota, solid waste disposal, socioeconomic, and health and safety. The guidance provided can be applied to preparation and/or review of proposals, environmental reports, environmental assessments, environmental impact statements, and other types of environmental analyses.

DOE

N83-23984# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.

CONTROL TECHNIQUES FOR PARTICULATE EMISSIONS FROM STATIONARY SOURCES, VOLUME 2 Final Report

Sep. 1982 670 p refs

(PB83-127480; EPA-450/3-81-005B-VOL-2) Avail. NTIS HC

A99/MF A01 CSCL 13B

Information on major sources of particulate emissions are given and techniques used to control emissions from these sources are discussed. Particulate size data for uncontrolled and controlled sources are included for many sources. Additionally, industrial process fugitive emission data and fugitive emission data are presented for some emission sources.

GRA

N83-24140# Department of Energy, Washington, D. C. Carbon Dioxide and Climate Research.

THE INTERESTS OF THE DEPARTMENT OF ENERGY IN THE EFFECTS OF CO₂ ON MAMMALIAN ORGANISMS

R. DAHLMAN /in Undersea Medical Society, Inc. Effect of CO₂ on Mammalian Organisms 9 p Dec. 1982

Avail. NTIS HC A06/MF A01

The prospect that carbon dioxide from the unrestrained combustion of fossil fuels may be potentially the most important environmental issue facing mankind. Current predictions call for a doubling of atmospheric carbon dioxide as early as 2030. Climate models, using these elevated levels, predict the possibility of significant dislocations in the global distribution of climate. Should such perturbations in the distribution of global temperature, cloudiness, precipitation, and wind occur, then it is clear that there could be major changes in the global physical characteristics of the oceans, and in the extent of the cryosphere.

Author

N83-24141# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Labs.

ATMOSPHERIC CO₂ CONCENTRATIONS

L. MACHTA /in Undersea Medical Society, Inc. Effect of CO₂ on Mammalian Organisms 7 p Dec. 1982

Avail. NTIS HC A06/MF A01

The atmospheric CO₂ concentrations are an increasing source of concern. The uncertainties in prediction of future levels are due to the validity of the projections. The largest of the potential errors lies in forecasting the results of future energy policies and the manner in which world energy needs are satisfied.

B.G.

N83-24429# Committee on Energy and Commerce (U. S. House).

RESOURCE CONSERVATION AND RECOVERY ACT REAUTHORIZATION

Washington GPO 1982 42 p Presented to the Comm. of the Whole House on the State of the Union, 97th Congr., 2d Sess., 18 May 1982

(H-REPT-97-570, GPO-89-081) Avail. US Capitol, House Document Room

Areas of concern discussed, included: state hazardous waste programs, resource conservation and recovery, hazardous waste site inventory, and recycled oil programs.

B.G.

N83-24430 Department of Energy (UK), London (England). Technology Support Unit.

PROSPECTS FOR IMPROVED FUEL ECONOMY AND FUEL FLEXIBILITY IN ROAD VEHICLES

R. J. FRANCIS and P. N. WOOLLACOTT Apr. 1981 119 p refs

(EP-45, ISBN-0-11-4109-5-X) Avail. Issuing Activity

The various technical options for improving the fuel economy and fuel flexibility of road vehicles are examined. It assumes that present loads, passenger capacity and performance should be maintained, and it takes into account noise and emissions considerations.

Author

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N83-24501# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France) Div Avions
THE RETURN OF THE PROPELLER AIRPLANE [LE RETOUR DE L'AVION A HELICE]

D BERGER and P. JACQUET 1982 29 p In FRENCH Presented 12th Salon Aeron. et Spatial de Toulouse "Journées d'Aeronautiques 1982", Toulouse, 15-19 Jun 1982 Sponsored by Assoc Aeron et Astronautique de France (SNIAS-822-111-102) Avail NTIS HC A03/MF A01

The cost of fuel, the properties of propellers, U S deregulation of domestic airlines, and the market for commuter and short-haul aircraft are reasons for renewed interest in propellers. The evolution of turbopropulsion technologies (propellers, gas generators, and soundproofing of fuselages) are increasing passenger comfort and reducing noise levels as well as fuel and maintenance costs. The results of research and studies by propeller, aircraft, and engine designers are manifested in new aircraft programs, in the American advanced turboprop project (propfan) financed by NASA, and in the French propellers for fast aircraft program. Transl by A R H

N83-24731# Newcomb and Boyd, Atlanta, Ga
STANDARDIZED EMCS ENERGY SAVINGS CALCULATIONS Final Report

C. CORNELIUS Port Hueneme, Calif. NCEL Sep. 1982 150 p (Contract N62474-81-C-9382) (AD-A123383, NCEL-CR-82 030) Avail NTIS HC A07/MF A01 CSDL 12A

This report describes standardized methods for determining energy savings obtainable from EMCS applications programs using manual and computerized algorithms. The methods will provide reasonable approximations of savings but not detailed energy analyses of building operations. Author (GRA)

N83-25055# Lincoln Lab., Mass Inst of Tech, Lexington
DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, NOVEMBER 1981

M C. RUSSELL, P RAGHURAMAN, and P C MAHONEY Dec. 1981 14 p (Contract DE-AC02-76ET-20279) (DOE/ET-20279/182) Avail NTIS HC A02/MF A01

Physical performance data obtained from photovoltaic energy systems under test are tabulated for November 1981. A R H

N83-25124# Department of Energy, Washington, D C.
REPORT TO THE CONGRESS: REGIONAL PETROLEUM RESERVES

31 Dec. 1982 68 p refs (DE83-005270; DOE/EP-0080) Avail: NTIS HC A04/MF A01

Actions taken to determine the benefits and costs of establishing in-region Regional Petroleum Reserves (RPR's) and the extent to which existing analyses reflect DOE's current assessments of US and world supply/demand conditions are discussed. A discussion of sites considered, cost comparisons of RPR and Gulf Coast storage, an SPR distribution capabilities and is continuing system enhancements is given. The SPR Plan of 1977, in its thorough analysis of SPR options, developed a basic program each which continues to be valid in today's petroleum market. Current assessments indicate that SPR system enhancements, current market strategies, and the removal of prior regulatory barriers will significantly increase the flexibility of the SPR system in providing protection to all regions and noncontiguous areas. The SPR, located in the Gulf Coast salt domes as crude oil, continues to represent the most practical, efficient, and effective means of providing flexibility, security, and low cost energy storage. DOE

N83-25126# Illinois Inst of Tech, Chicago Dept of Mechanical Engineering

FEASIBILITY CASE STUDY OF GAS-TURBINE DIRECT-HEAT INDUSTRIAL COGENERATION

K. MASTANAIAH and R W PORTER Mar 1982 13 p refs (Contract DE-FG02-80CS-40337) (DE83-005655, DOE/CS-40377/1) Avail: NTIS HC A02/MF A01

A case study is presented here for the evaluation of economic feasibility of using gas-turbine cogeneration for a process industry requiring annual-average direct heat for certain dryers of about 32 210 (6)B/hr. The results of the economic analysis indicated that none of the alternatives considered are acceptably attractive, the best of them yielding only about 7% real return on investment (ROI) (15% effective ROI) after taxes, subject to the assumptions used. The low return on investment in this particular case is attributed to the relatively low cost of utility electric power at the margin for this particular company, and the fact that the size of the equipment required was too small in order to utilize more cost-effective turbines of a larger size. DOE

N83-25138# Theisen (Phillip), Madison, Wis

LOW-COST PROCESS-HEAT RECOVERY Final Report

P THEISEN and J. MCCRAY 26 May 1982 24 p refs (Contract DE-FG02-80R5-10251) (DE82-016652, DOE/R5-10251/T1) Avail: NTIS HC A02/MF A01

Heat recovery systems developed specifically for use with gas-fired ovens such as those used in restaurants and bakeries are found to be a viable energy saving option for reducing operating expenses. The objectives of the work are: to assess waste heat recovery potential, perform an economic analysis, design heat exchanger and system, develop an integrated computer program. The first three objectives were successfully met for flat plate and plate fin air to air heat recovery systems. An interactive computer program is developed for heat recovery systems using the FORTRAN language, and an economic analysis program is developed. DOE

N83-25153# Battelle Human Affairs Research Centers, Seattle, Wash

US DEPARTMENT OF ENERGY WIND TURBINE CANDIDATE SITE PROGRAM: THE REGULATORY PROCESS

M R GREENE and K R YORK Jun 1982 94 p refs (Contract DE-AC06-76RL-01830) (DE82-018444, PNL-4066) Avail: NTIS HC A05/MF A01

Sites selected in 1979 as tentative sites for installation of a demonstration MOD-2 turbine are emphasized. Selection as a candidate site in this program meant that the US Department of Energy (DOE) designated the site as eligible for a DOE-purchased and installed meteorological tower. The regulatory procedures which involved in the siting and installation of meteorological towers at the majority of the candidate sites are examined. The legal and regulatory procedures required to put up a turbine at each of these candidate sites are identified. The major findings are summarized on the following: federal requirements, state requirements, local requirements, land ownership, wind rights, and public attitudes. DOE

N83-25198# Synergic Resources Corp., Bala-Cynwyd, Pa
EVALUATION OF DUAL-ENERGY-USE SYSTEMS. VOLUME 1: EXECUTIVE SUMMARY Interim Report

D R. LIMAYE Oct 1982 33 p refs 2 Vol (Contract EPRI PROJ 1276-8) (DE83-900758, EPRI-EM-2695-VOL-1) Avail: NTIS HC A03/MF A01

The potential applications of industrial cogeneration and district heating are addressed. The following are described: purpose and objectives, project overview, major tasks, project schedule, industrial cogeneration case studies, list of cogeneration systems studied, cogeneration data base, summary of cogeneration inventory, evaluation methodology, computer programs for screening and evaluation of DEUS, conceptual design of

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cogeneration systems in a pulp mill, West Coast mill results, conceptual design of cogeneration system for enhanced oil recovery, cogeneration systems Tosco site, preliminary evaluation of cogeneration potential in distillation columns, district heating survey, US vs European district heating technology, and utility participation in DEUS regulatory and financial aspects. DOE

N83-25210# Department of Energy, Washington, D. C. Div. of Advanced Energy Projects.

ADVANCED ENERGY PROJECTS: FY 1982 RESEARCH SUMMARIES

Oct. 1982 34 p

(DE83-003140, DOE/ER-0150) Avail NTIS HC A03/MF A01

Projects in advanced energy are summarized. The following topics are included: program description, summaries of active projects; program data; an investigator index; and an institutional index E.A.K.

N83-25211# Illinois Inst. of Tech., Chicago. Dept of Mechanical Engineering

FEASIBILITY OF A SMALL CENTRAL COGENERATED ENERGY FACILITY: ENERGY MANAGEMENT MEMORANDUM

R N. PORTER Oct. 1982 31 p refs

(Contract DE-FG02-80CS-40337)

(DE83-005083; DOE/CS-40337/6, TM-82-6A) Avail. NTIS HC A03/MF A01

The thermal economic feasibility of a small cogenerated energy facility designed to serve several industries in the Stockyards area was investigated. Cogeneration options included two dual fuel diesels and two gas turbines, all with waste heat boilers, and five fired boilers. Fuels included natural gas, and for the fired boiler cases, also low sulphur coal and municipal refuse. For coal and refuse, the option of steam only without cogeneration was also assessed. The fired boiler cogeneration systems employed back pressure steam turbines. The refuse fired cases utilized electrical capacities, 8500 to 52,400 lbm/hr and 0 to 9.9 MW (e), respectively. Deficient steam was assumed generated independently in existing equipment. Excess electrical power over that which was displaced was sold to Commonwealth Edison Company under PURPA (Public Utility Regulatory Policies Act). The facility was operated by a mutually owned corporation formed by the cogenerated power users. DOE

N83-25218# Oak Ridge National Lab., Tenn. Environmental Sciences Div.

ENVIRONMENTAL SCIENCES DIVISION REPORT Annual Progress Report, period ending 30 Sep. 1981

Apr 1982 223 p refs

(Contract W-7405-ENG-26)

(ORNL-5900; PUBL-1900) Avail NTIS HC A10/MF A01

Aquatic ecology activities reported include results from the growing projects on reservoir and stream studies and on Legionnaires' Disease Bacterium. Also included are the final results from the two long term projects on analysis and modeling of aquatic populations and ecosystems and on toxicant formation in condenser cooling systems. Research in the Environmental Resources Section included regional pattern analysis, large waterway regional analyses, regional analysis of likely impacts of coal production and use in the Western Kentucky area, regional wildlife habitat analysis, acidic deposition, and evaluation of potential conflicts between mineral deposits and renewable resources in the conterminous United States. Modeling studies included ecosystem risk analysis, the study of aggregation problems in ecology, and work on positive feedback in natural systems. *Environmetrics* emphasized organization, management, and reporting for several large data sets used for examining the effects of by products of synthetic fuel manufacture on various biota; reporting lower Mississippi River impacts studied by the U.S. Army Corps of Engineers, reporting gasifier research data from the University of Minnesota; studying global carbon issues, and correlating information in the Geoecology data base with country wide issues. Research park activities emphasized characterization of Oak Ridge Reservation communities, habitat studies for wildlife

on an interagency basis, management of softwood plantations, and management and research on reservation wildlife populations. Author

N83-25219# PEDCo-Environmental, Inc., Cincinnati, Ohio.

ACID RAIN: COMMENTARY ON CONTROVERSIAL ISSUES AND OBSERVATIONS ON THE ROLE OF FUEL BURNING

M F SZABO, M. P ESPOSITO (Spate (Paul W.) Co.), and P W. SPAITE Mar. 1982 211 p refs

(Contract DE-AC21-81MC-19170)

(DE82-016914; DOE/MC-19170/1168) Avail. NTIS HC A10/MF A01

Occurrence and effects of acid rain; natural and manmade sources of acid rain precursors, formation, transport, and deposition, measurement and monitoring, mathematical modeling, fuel trend analysis, and the impact of local sources are discussed. Author

N83-25231# Institute of Gas Technology, Chicago, Ill

ENVIRONMENTAL ASSESSMENT OF THE HYGAS PROCESS.

VOLUME 4: HYGAS ENVIRONMENTAL CHARACTERIZATION. HYGAS TESTS 65 THROUGH 76 Interim Report

L. J. ANASTASIA, R. J. EVANS, S. J. BOSSART, R. H. KARST, and C. S. JUAN Feb. 1982 241 p

(Contract DE-AC01-76ET-10261)

(DE82-011012, DOE/ET-10261/T5-VOL-4, FE-2433-27-VOL-4)

Avail: NTIS HC A11/MF A01

HYGAS pilot plant streams were systematically sampled and analyzed to determine the fate of potential pollutants generated during coal gasification. Data acquisition and interpretation for pilot plant tests using a washed Illinois No. 6 bituminous coal from Peabody Min 10 were discussed. The pilot plant units of interest include the pretreater and gasifier reactors, which are considered scalable to larger HYGAS coal gasification plants. The fates of the following environmentally significant coal constituents were studied during pretreatment: sulfur compounds, nitrogen compounds, trace elements, and analyzed coal feeds, pretreated chars, overhead fines, tars and oil, quenched water, and quenched off-gas. DOE

N83-25233# Brookhaven National Lab., Upton, N. Y.

LESSENING THE SCOPE OF FEDERAL COASTAL ZONE MANAGEMENT: WHAT'S AT STAKE

E KAPLAN and R RITSCHARD (California Univ., Lawrence Berkeley Lab.) Jun 1982 49 p refs

(Contract DE-AC03-76SF-00098, DE-AC02-76CH-00016)

(DE83-004048, LBL-14164, BNL-30948) Avail NTIS HC

A03/MF A01

The coastal zone management (CZM) program is discussed. The present scope of federal and state involvement in coastal zone management is reviewed particularly in relation to energy development. The impact of decreased federal coastal zone funding is outlined. Important issues of national interest and consistency are reviewed using specific examples. The need for an effective coastal planning and management scheme is discussed. DOE

N83-25624# General Accounting Office, Washington, D. C. Resources, Community and Economic Development Div.

ANALYSIS OF THE COMPREHENSIVE ENERGY EMERGENCY RESPONSE PROCEDURES REPORT

17 Feb. 1982 39 p refs

(GAO/RCED-83-106; B-210236) Avail: NTIS HC A03/MF A01

The objectives, scope, and methodology used to assess the administration's procedures for responding to energy emergencies in the light of requirements of the Energy Emergency Preparedness Act of 1982 are described. The GAO determined that the comprehensive procedures report lacks the desired specificity in describing options to be considered and the methods for implementing them. In addition, key parts of the administration's programs are still not ready. A.R.H.

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N83-25707*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DESCRIPTION OF THE COMPUTATIONS AND PILOT PROCEDURES FOR PLANNING FUEL-CONSERVATIVE DESCENTS WITH A SMALL PROGRAMMABLE CALCULATOR
D. D. VICROY and C. E. KNOX May 1983 37 p refs
(NASA-TM-85642; NAS 1.15:85642) Avail: NTIS HC A03/MF A01 CSCL 01D

A simplified flight management descent algorithm was developed and programmed on a small programmable calculator. It was designed to aid the pilot in planning and executing a fuel conservative descent to arrive at a metering fix at a time designated by the air traffic control system. The algorithm may also be used for planning fuel conservative descents when time is not a consideration. The descent path was calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard temperature effects. The flight management descent algorithm and the vertical performance modeling required for the DC-10 airplane is described. Author

N83-25919# Transportation Research and Marketing, Salt Lake City, Utah

TRANSPORTATION ENERGY CONSERVATION THROUGH LAND USE PLANNING Final Report
Jun. 1982 58 p refs Conf. held in Washington, D.C., 5-6 Nov. 1981 Sponsored in part by the FHA
(PB83-148387, DOT-1-82-50) Avail: NTIS HC A04/MF A01 CSCL 13B

The interrelationships of transportation, land use and energy are covered. Two major areas were highlighted; the fundamental social, economic, energy, and cultural factors that influence planning, and opportunities for the coordination of transportation and land use. Although no specific recommendations are contained, highlight examples of effective plans and programs and questions that can form the basis for further research are described. GRA

N83-26195*# Pennsylvania Power and Light Co., Allentown.
ENERGY FACILITY SITING BY MEANS OF ENVIRONMENTAL MODELLING WITH LANDSAT, THEMATIC MAPPER AND GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

/In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 2 p 538-540 1982 ERTS
Avail: NTIS HC A18/MF A01 CSCL 05B

Currently based on ground and aerial surveys, the land cover data base of the Pennsylvania Power and Light Company is routinely used for modelling the effects of alternative generating plant and transmission line sites on the local and regional environment. The development of a satellite-based geographic information system would facilitate both the preparation of environmental impact statements by power companies and assessment of the data by the Nuclear Regulatory Commission. A cooperative project is planned to demonstrate the methodology for integrating satellite data into an existing geographic information system, and to further evaluate the ability of satellite data in modeling environmental conditions that would be applied in the preparation and assessment of environmental impact statements. A R H.

N83-26196*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ENERGY REMOTE SENSING APPLICATIONS PROJECTS AT THE NASA AMES RESEARCH CENTER
S. D. NORMAN, W. C. LIKENS, and D. A. MOUAT /In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 2 p 543-551 1982 refs ERTS
Avail: NTIS HC A18/MF A01 CSCL 05A

The NASA Ames Research Center is active in energy projects primarily in the role of providing assistance to users in the solution of a number of problems related to energy. Data bases were produced which can be used, in combination with other sources of information, to solve spatially related energy problems. Six project activities at Ames are described which relate to energy and remote sensing. Two projects involve power demand

forecasting and estimations using remote sensing and geographic information systems, two others involve transmission line routing and corridor analysis, one involves a synfuel user needs assessment through remote sensing, and the sixth involves the siting of energy facilities. A R H.

N83-26197*# Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning

A METHODOLOGY FOR ASSESSING THE REGIONAL TRANSPORTATION ENERGY DEMANDS OF DIFFERENT SPATIAL RESIDENTIAL DEVELOPMENT SCENARIOS: A CASE STUDY FOR THE UPPER HOUSATONIC RIVER BASIN, MASSACHUSETTS

J. A. OSKI, J. G. FABOS, and M. GROSS /In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 2 p 552-565 1982 refs ERTS
Avail: NTIS HC A18/MF A01 CSCL 05A

A method is suggested whereby regional landscape planning efforts can be aided by the use of a geographic information system to determine sites for more energy efficient residential and mixed use developments within a study area. The location of land parcels suited for residential and mixed land use developments in the Upper Housatonic River Basin Study Area in Berkshire County, Massachusetts is described as well as the three development options. Significant steps in the procedure are discussed and the computation of the transportation energy requirement is elaborated. A R H.

N83-26198*# Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.

ASSESSMENT PLANNING AND EVALUATION OF RENEWABLE ENERGY RESOURCES: AN INTERACTIVE COMPUTER ASSISTED PROCEDURE

T. W. ASTON, J. G. FABOS, and E. B. MACDOUGALL /In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 2 p 566-588 1982 refs ERTS
Avail: NTIS HC A18/MF A01 CSCL 09B

Adaptation and derivation were used to develop a procedure for assessing the availability of renewable energy resources on the landscape while simultaneously accounting for the economic, legal, social, and environmental issues required. Done in a step-by-step fashion, the procedure can be used interactively at the computer terminals. Its application in determining the hydroelectricity, biomass, and windpower in a 40,000 acre study area of Western Massachusetts shows that: (1) three existing dam sites are physically capable of being retrofitted for hydropower; (2) each of three general areas has a mean annual windspeed exceeding 14 mph and is conducive to windpower, and (3) 20% of the total land area consists of prime agricultural biomass while 30% of the area is prime forest biomass land. A R H.

N83-26199*# City of Seattle, Wash. City Light Dept.

SEATTLE'S SYSTEM FOR EVALUATING ENERGY OPTIONS

P. LOGIE and M. J. MACDONALD /In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 2 p 589-596 1982 ERTS
Avail: NTIS HC A18/MF A01 CSCL 10B

In 1975, the City Council developed a blueprint called 'Energy 1990' for meeting Seattle's future electric energy needs. Priorities for addressing or offsetting expected growth in demand are in order: (1) conservation, (2) hydroelectricity, (3) other renewable sources such as wind, biomass, solar, and geothermal energy, (4) abundant nonrenewable resources such as coal, and (5) other renewables. An energy resources planning group was formed and a data base was established. Resource options were investigated and the recommendations were published. A R H.

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

N83-26226# Energy Information Administration, Washington, D.C.
Office of Coal, Nuclear, Electric and Alternate Fuels

OUTLOOK FOR US COAL

E. TUKENMEZ and M. K. PAULL Aug. 1982 47 p
(DE82-020509; DOE/EIA-0333) Avail: NTIS HC A03/MF A01

This report on the outlook for US coal summarizes the historical development of coal in the United States from both the supply and demand perspectives. The report traces coal use from the 1800's, when it displaced wood, through the 1900's, when oil and natural gas, (cleaner and, until recently, cheaper) became the primary fuels. Projections from EIA's 1981 Annual Report to Congress, Volume 3, show that coal is expected to regain a dominant position as a domestic fuel source. These projections and factors affecting coal's future growth are discussed in this report. DOE

N83-26238# Dames and Moore, Anchorage, Alaska

NATURAL RESOURCE PROTECTION AND PETROLEUM DEVELOPMENT IN ALASKA

P. T. HANLEY, J. E. HEMMING, J. W. MORSELL, T. A. MOREHOUSE (Inst. of Social and Economic Research, Anchorage, Alaska), L. E. LEASK (Inst. of Social and Economic Research, Anchorage, Alaska), and G. S. HARRISON (Harrison (Gordon S.) and Associates, Tacoma, Wash.) Aug 1981 327 p refs
(Contract DI-14-16-0009-79-123)
(PB83-150748; FWS/OBS-80/22, LC-82-600620) Avail: NTIS HC A15/MF A01 CSCL 08I

Administrative roles, authorities, procedures, and decisionmaking processes for oil and gas leasing and post-lease environmental management for both the State and Federal governments are reviewed. Past and present oil exploration and development efforts in Alaska, and a general assessment of the most promising areas for future exploration are reviewed. Two case studies of petroleum development and environmental management in Alaska are given, the Kenai National Moose Range in southcentral Alaska and the National Petroleum Reserve in northern Alaska. GRA

N83-26256*# Jet Propulsion Lab., California Inst. of Tech., Pasadena

ADVANCED COGENERATION RESEARCH STUDY. SURVEY OF COGENERATION POTENTIAL

M. L. SLOSKI May 1983 59 p refs Sponsored by Southern California Edison Co.
(NASA-CR-172648; JPL-PUBL-83-40, NAS 1 26:172648) Avail: NTIS HC A04/MF A01 CSCL 10B

Fifty-five facilities that consumed substantial amounts of electricity, natural gas, or fuel oil were surveyed by telephone in 1983. The primary objective of the survey was to estimate the potential electricity that could be generated in the SCE service territory using cogeneration technology. An estimated 3667 MW sub e could potentially be generated using cogenerated technology. Of this total, current technology could provide 2569 MW sub p and advanced technology could provide 1098 MW sub e. Approximately 1611 MW sub t was considered not feasible to produce electricity with either current or advanced cogeneration technology. Author

N83-26260# RAND Corp., Santa Monica, Calif.

RESIDENTIAL DEMAND FOR ENERGY: A REVIEW OF THE EMPIRICAL LITERATURE AND SOME NEW RESULTS

S. N. KIRBY Jan 1983 59 p refs
(P-6847) Avail: NTIS HC A04/MF A01

Demand for energy is derived from the demand for particular end-use service (e.g., warmth, cooling, clothes drying, etc.). This derivative nature of energy demand gives rise to two major, although interrelated, issues: first, a complete model must consider both the demand for services and the demand for energy-using equipment; second, the essentially dynamic nature of the demand requires a clear delineation between short-run and long-run responses. Because of their durability, appliance stocks will be adjusted only over a period of time. In contrast, the intensity of utilization of a given appliance portfolio can be adjusted fairly

rapidly. In the short run, defined as the period of time during which appliance stocks are fixed, households are essentially limited in their ability to respond to changes in fuel prices and income. In the long run, households may alter their stock of energy using equipment to reflect more accurately their desired capital stock. As such, longer run responses will be much larger in magnitude than short run responses. Author

N83-26263# Kling-Lindquist, Inc., Philadelphia, Pa

ENERGY MONITORING AND CONTROL SYSTEMS-PERFORMANCE VERIFICATION AND ENDURANCE TEST PROCEDURES Final Report

J. COSIOL and F. BOMAR Port Hueneme, Calif. NCEL Dec. 1982 188 p
(Contract N62474-81-C-9373)
(AD-A123821; NCEL-CR-83.003) Avail: NTIS HC A09/MF A01 CSCL 09B

This report presents generic tests designed to assist in assuring that EMCS installed using the tri-service EMCS guide specifications meet the specified technical, operational, and performance requirements. GRA

N83-26307# National Academy of Sciences - National Research Council, Arlington, Va.

RESEARCH AGENDA: ENERGY CONSERVATION IN BUILDINGS AND COMMUNITY SYSTEMS

1982 63 p refs
(Contract DE-AC01-77CS-20436)
(DE82-019465; DOE/CS-20436/T1) Avail: NTIS HC A04/MF A01

An agenda is presented on research needs in the field of energy conservation within buildings and communities to be supported by the federal government. The agenda is developed in a futures perspective, presenting material that would be relevant for research and development five or more years from the present. An overview is provided of agenda setting in general, pointing out some of the difficulties as well as possible approaches that any group might encounter while planning research for future, as yet unspecified, needs. A set of boundary conditions was created to help determine subject areas that should be part of this agenda. Twenty-seven subjects are described as appropriate for areas of research. They are organized into six categories - broad classes of interest under which all related research can be grouped. A description of each category and area is provided, along with suggested topics of specific research projects. DOE

N83-26308# Massachusetts Inst of Tech., Cambridge Energy Lab

RESIDENTIAL-ENERGY-DEMAND MODELING AND THE NIECS DATA BASE: AN EVALUATION

T. G. COWING, J. A. DUBIN, and D. MCFADDEN Jan. 1982 250 p refs
(Contract DE-AM01-76EI-02295)
(DE82-013659; MIT-EL-82-009) Avail: NTIS HC A11/MF A01

The 1978-1979 National Interim Energy Consumption Survey (NIECS) data base was evaluated in terms of its usefulness for estimating residential energy demand models based on household appliance choice and utilization decisions. The NIECS contains detailed energy usage information at the household level for 4081 households during the April 1978 to March 1979 period. Among the data included are information on the structural and thermal characteristics of the housing unit, demographic characteristics of the household, fuel usage, appliance characteristics, and actual energy consumption. The survey covers the four primary residential fuels-electricity, natural gas, fuel oil, and liquefied petroleum gas - and includes detailed information on recent household conservation and retrofit activities. DOE

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

N83-26309# TRW, Inc., Oak Ridge, Tenn.
THE RD/D OPPORTUNITIES FOR LARGE AIR-CONDITIONING AND HEAT-PUMP SYSTEMS Final Report
M MACDONALD, D GOLDENBERG, and E. HUDGINS Jun. 1982 136 p refs
(Contract W-7405-ENG-26)
(DE82-018406, ORNL/SUB-80-13817/1) Avail. NTIS HC A07/MF A01

The marketplace factors that constrain a more rapid implementation of energy-conserving heating, ventilating, and air conditioning (HVAC) systems and system operation in commercial buildings are summarized. The focus was on large air conditioning and heat pump equipment Use of currently available energy-efficient equipment and systems is presently limited by the economic situation of the building owners. Although case histories of energy-efficient buildings highlight the potential of new and existing equipment and systems, the majority of systems and equipment being installed today do not measure up to that potential. The major recommendations deal with developing the market for energy-efficient HVAC systems by reversing existing market forces that promote energy consumption, promoting technical research and educational programs, increasing the number of technical people competent in the area of high-efficiency system application and maintenance DOE

N83-26310# Pacific Northwest Lab., Richland, Wash
THE US ENERGY CONVERSION AND USE CHARACTERISTICS
C H IMHOFF, A LIBERMAN, and W B ASHTON Feb 1982 262 p refs
(Contract DE-AC06-76RL-01830)
(DE82-008616, PNL-4075) Avail. NTIS HC A12/MF A01

The long-range goal of the Energy Conversion and Utilization Tehnology (ECUT) Program is to enhance energy productivity in all energy-use sectors by supporting research on improved efficiency and fuel switching capability in the conversion and utilization of energy Regardless of the deficiencies of current information, a summary of the best available energy-use information is needed now to support current ECUT program planning. This document is the initial draft of this type of summary and serves as a data book that will present current and periodically updated descriptions of the following aspects of energy use gross US energy consumption in each major energy-use sector; energy consumption by fuel type in each sector, energy efficiency of major equipment/processes, and inventories, replacement rates, and use patterns for major energy-using capital stocks DOE

N83-26315# National Oceanic and Atmospheric Administration, Washington, D. C Office of Ocean Minerals and Energy.
OCEAN THERMAL ENERGY CONVERSION: ENVIRONMENTAL EFFECTS ASSESSMENT PROGRAM PLAN 1981-1985
Jun. 1982 63 p refs
(PB83-142570, NOAA/T-82-188; NOAA-82111702) Avail. NTIS HC A04/MF A01 CSCL 10B

This plan describes the program of research for FY 1981-1985 that is necessary to begin to assess the effects on the environment of ocean thermal energy conversion facilities and plantships. GRA

N83-26411# Air Force Occupational and Environmental Health Lab., Brooks AFB, Tex
EVALUATING HEALTH HAZARDS ASSOCIATED WITH AIRCRAFT FUEL CELL MAINTENANCE
E. C. BISHOP /In Calif Univ. Proc. of the 12th Conf. on Environ. Toxicol p 192-202 Apr. 1982 refs
(PAPER-12) Avail. NTIS HC A16/MF A01 CSCL 06C

Problems commonly encountered when toxicologic standards are applied to everyday worker exposures are demonstrated. The primary function of the industrial hygienist is to evaluate the workplace to insure a healthful environment for the worker. In general, this evaluation is accomplished by taking samples representative of the worker's environment, analyzing for contaminants of interest, and comparing the measured levels with

appropriate standards Control measures are instituted if contaminant levels are above the standard or some present fraction of the standard (NIOSH action level concept) Although the evaluation procedure may seem simple as described, it is a nontrivial task as demonstrated using the example of a recent evaluation of worker exposures during aircraft fuel cell maintenance Author

N83-26741# Energy Information Administration, Washington, D.C.
EIA PUBLICATIONS DIRECTORY, A USER'S GUIDE, 1981 Annual Report
Apr. 1982 278 p
(DE83-006474, DOE/EIA-0149(77-81)) Avail. NTIS HC A13/MF A01

Abstracts of publication dealing with energy use and energy technology are given. Listings are given for coal, crude oil, fuel oils, marketing, and transportation energy DOE

N83-26755# Committee on Appropriations (U S. House)
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATION ACT, 1984
Washington GPO 1983 43 p A bill referred to the Comm. on Appropriations, 98th Congr 1st Sess., 24 May 1983 (H-REPT-98-223) Avail. US Capitol, House Document Room
The budget appropriations for FY 1983 for the National Science Foundation, the National Aeronautics and Space Administration, the Department of Housing and Urban Development-Independent Agencies are presented.

N83-26764# Los Alamos Scientific Lab., N Mex
OUTLOOK FOR IMPROVED AUTOMOBILE FUEL EFFICIENCY
A. FORD and R J SUTHERLAND Jun 1982 125 p refs
(Contract W-7405-ENG-36)
(DE82-018349; LA-9414-MS) Avail. NTIS HC A06/MF A01

The prospects of improved fuel efficiency in new cars through 1995 are analyzed The costs of retooling and the optimal rate of retooling as a function of the price of gasoline and the discounted life of the car are estimated With these estimates, and an econometric model of market shares of five car classes, it is estimated that the average new fleet fuel efficiency will be 32 mpg in 1985 and about 39 mpg in 1995 if all car classes are optimally retooled If only three of five car classes are retooled, the new car fleet should obtain 31 mpg in 1985, which exceeds the Government mandated 27.5 mpg. Three potential policies - differential pricing, gas guzzler tax, and a gasoline tax are examined in terms of their cost and effectiveness of shifting the mix in demand for new cars and thereby improving overall fuel economy These policies would produce a large redistribution of expenditures, and only a moderate improvement in fuel efficiency would be achieved. DOE

N83-26766# Environmental Protection Agency, Ann Arbor, Mich Control Technology Assessment and Characterization Branch.
THE EFFECTS OF ACCELERATION RATE ON VEHICLE EXHAUST EMISSIONS AND FUEL ECONOMY
L. C LANDMAN Aug 1982 141 p refs
(PB83-142711, EPA/AA/CTAB/TA/82-2) Avail. NTIS HC A07/MF A01 CSCL 13F

This report summarizes a test program which was designed to explore the impact on exhaust emissions and fuel economy of coupling the dynamometer rollers (front and rear) and of using acceleration rates higher than those used on the Federal Test Procedure (FTP) A total of six vehicles were tested in this program. All five gasoline-fueled exhibited increases in hydrocarbons (HC) and carbon monoxide (CO) emissions on the Federal Test Procedure (FTP) driving cycle when the dynamometer rollers were coupled The other results are strongly vehicle dependent. Author

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N83-27108# General Electric Co., Cleveland, Ohio. Fluorescent Systems Dept.

CONDUCTED AND RADIATED SIGNATURES OF FLUORESCENT LAMP SYSTEMS IN C AND I ENVIRONMENTS
S. JAVIDI /In LBL Proc. of the Lightning-Electromagnetic Compatibility Conf. p 53-73 Sep. 1982

Avail: NTIS HC A06/MF A01

The power line conducted EMI and radiated EMI generated by four samples of electronic fluorescent ballasts, and four samples of electromagnetic ballasts are presented. Conducted and radiated test protocols are given for these experiments. Proposed FCC limits under Part 18 of Rules and Regulations are compared to the EMI levels of the test samples. Author

N83-27348*# Engelhard Corp., Menlo Park, Calif.

DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEM Quarterly Report

A. KAUFMAN and G. K. JOHNSON 20 Apr. 1983 26 p

(Contract DEN3-241; DE-AI-01-80ET-17088)

(NASA-CR-168021; NAS 1 26-168021; QR-6) Avail: NTIS HC A03/MF A01 CSCL 10A

Satisfactory performance is reported for the first three 12-cell sub-stacks of the 5kW stack rebuild. Early general conclusions are presented from an economic study of OS/IES. Results are reported on a successful 700-hour test of a 3-cell stack in the full-sized configuration (0.33m x 0.56m). Construction of a 5-kW-equivalent methanol/steam reformer based on a commercial shell-and-tube heat exchanger was completed. Several test runs are summarized. Preliminary conclusions are presented on the technical and economic aspects of fuel cell/HVAC interaction for OS/IES as developed. Physical data are presented on several dense graphite materials which are candidates for gas-distribution plates. Performance of a new cathode catalyst is reported. Author

N83-27379# University of Southeastern Massachusetts, North Dartmouth. Dept. of Mechanical Engineering

OVERVIEW OF WORLDWIDE GEOTHERMAL POWER DEVELOPMENT

R. DIPIPPA /In Atlas Corp. Proc. of the 6th Ann. Geothermal Conf. and Workshop 12 p Dec. 1982 refs

Avail: NTIS HC A13/MF A01

The progress in geothermal power plant development around the world is reviewed. From an installed capacity of about 150 MW, the worldwide geothermal electric capacity now stands at roughly 2550 MW. The status of geothermal installed capacity is given. Over 120 individual power units (i.e., turbo-generator sets) are now in operation. It is interesting to note that one third of these are in Italy, the country that began the commercial generation of electricity from geothermal energy. The recent growth pattern is shown. There has been an increase of 45%, and the installed capacity is expected to exceed 4400 MW, a 150% increase. S.L.

N83-27430# Oak Ridge National Lab., Tenn. Environmental Sciences Div.

TESTIMONY PRESENTED TO SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS, US HOUSE OF REPRESENTATIVES. HEARINGS ON RENEWABLE ENERGY IN THE EIGHTIES: NEEDS FOR FURTHER RESEARCH, DEVELOPMENT AND DEMONSTRATION

J. W. RANNEY 1982 13 p Hearings held in Knoxville, Tenn., 28 May 1982

(Contract W-7405-ENG-26)

(DE82-017407; CONF-820599-1) Avail: NTIS HC A02/MF A01

The definition and significance of short rotation intensive culture are discussed. The major areas of research and research results are presented. DOE

N83-27469# Mitre Corp., McLean, Va

STATUS OF THE DOE BATTERY AND ELECTROCHEMICAL TECHNOLOGY PROGRAM, 3

R. ROBERTS Feb. 1982 313 p refs Prepared for Lawrence Berkeley Lab., Calif.

(Contract DE-AC03-76SF-00098)

(DE82-018912; LBL-14438; MTR-81W223) Avail: NTIS HC A14/MF A01

The potential contributions of the battery and electrochemical technology efforts to electric vehicles, solar electric systems, and energy conservation in industrial electrochemical processes, are reviewed. The analyses of the potential impact of these systems on energy technologies as the basis for selecting specific battery systems for investigation are noted. The battery systems in the research, development, and demonstration phase discussed include: aqueous mobile batteries (near term) - lead-acid, iron/nickel-oxide, zinc/nickel-oxide; advanced batteries - aluminum/air, iron/air, zinc/bromine, zinc/ferricyanide, chronous/ferric, lithium/metal sulfide, sodium/sulfur; and exploratory batteries - lithium organic electrolyte, lithium/polymer electrolyte, sodium/sulfur (IV) chloroaluminate, calcium/iron disulfide, lithium/solid electrolyte. Supporting research on electrode reactions, cell performance modeling, new battery materials, ionic conducting solid electrolytes, and electrocatalysis is reviewed. Potential energy saving processes for the electrowinning of aluminum and zinc, and for the electrosynthesis of inorganic and organic compounds are included. DOE

N83-27470# Oak Ridge National Lab., Tenn. Energy Div.

ECONOMIC EVALUATION OF END-USER CONSERVATION MEASURES APPLIED TO BUILDINGS SERVED BY A PROPOSED DISTRICT-HEATING SYSTEM

M. EKSEL (Tennessee Univ.), W. G. SULLIVAN (Tennessee Univ.), G. D. PINE, and M. A. KARNITZ May 1982 56 p refs

(Contract W-7405-ENG-26)

(DE82-016080, ORNL/TM-8277) Avail: NTIS HC A04/MF A01

The economic implications of applying end user conservation measures to buildings that are served by a proposed district heating system in the Minneapolis-St. Paul area are examined. End user conservation is a demand side conservation strategy typified by changes in building operating procedures and changes in the building shell. District heating with cogeneration is a supply side conservation method that allows scarce fossil fuels to be more efficiently converted into thermal and electrical energy. Technically, these two conservation methods can be applied simultaneously to a densely populated urban area such as Minneapolis-St. Paul, but the implementation of one tends to reduce the economic feasibility of the other. This analysis suggests that building conservation measures will be difficult to justify economically in buildings that are connected to the proposed Minneapolis-St. Paul system. DOE

N83-27471# One America, Inc., Washington, D.C.

WASTE-TO-ENERGY COMPENDIUM: REVISED 1982 EDITION

Aug. 1982 296 p refs

(Contract DE-AC01-80CS-24312)

(DE82-020328; DOE/CS-24312/1) Avail: NTIS HC A13/MF A01

This report surveys 49 waste-to-energy recovery projects throughout the United States. Included are ten refuse-derived fuel (RDF) production facilities, eight RDF user facilities, five combined RDF production-user facilities, and 26 mass burning facilities with energy recovery. Only those facilities that are fully operational or those in advanced stages of startup and shakedown are surveyed. Information is provided on processing capacities, operation and maintenance problems, equipment specifications, capital and operating costs, and the current status of each facility. In addition, process flow schematics are provided for each of the ten RDF production plants and the five RDF production-user plants. DOE

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N83-27472# Center for Renewable Resources, Washington, D.C.

PUTTING RENEWABLE ENERGY TO WORK IN CITIES

G MARA Jun 1982 447 p refs

(Contract DE-AC01-79ET-20622)

(DE82-017237; DOE/ET-20622/1) Avail NTIS HC A19/MF A01

Guidelines are provided to help local energy officials assess their own urban energy contexts, and indications are given of how different energy technologies might fit within different city contexts or neighborhoods. Applications discussed include domestic hot water, heating and cooling of buildings, and community heating and cooling systems. Electricity, industrial process heat and fuels from renewable resources are included. Incremental planning as a way of making the best use of scarce resources is discussed, and the conservation and renewable options are overviewed. Land use for energy programs is discussed, and the kind of information needed on the city's existing building stock is given. Information needed on energy supply and distribution is also discussed. Socioeconomic factors of the city's energy and situation and related action are described. DOE

N83-27474# Resource Transitions, Inc., Santa Cruz, Calif **ENERGY FUTURE SANTA CRUZ. A CITIZENS PLAN FOR ENERGY SELF-RELIANCE: EXECUTIVE SUMMARY**

J COHN and R STAYTON 1982 12 p

(Contract NSF OSS-80-16323)

(PB83-136978; NSF/OSS-82004) Avail: NTIS HC A02/MF A01
CSCL 10A

A grassroots energy conservation project which involved more than 3100 residents of Santa Cruz, California, is discussed. Citizens attended forums and town meetings to suggest ideas for solving the community's energy problems. These ideas were then evaluated by the Energy Future Advisory Board and compiled into the Energy Future Plan. The plan covers such topics as new residences, residential retrofit, automobile efficiency, farm efficiency, commercial greenhouses, local food production, commercial efficiency, land use planning, energy education and financing, and solar, wind, and ocean energy. If the plan is successfully implemented, the energy that the community is projected to use in 1991 can be lowered by 24 to 35 percent. GRA

N83-27475# Resource Transitions, Inc., Santa Cruz, Calif **ENERGY FUTURE SANTA CRUZ: A CITIZENS' PLAN FOR ENERGY SELF-RELIANCE**

J COHN and R STAYTON 1982 104 p refs

(Contract NSF OSS-80-16323)

(PB83-136960; NSF/OSS-82003) Avail: NTIS HC A06/MF A01
CSCL 10A

The results of a grassroots energy conservation project which involved more than 3,100 residents of Santa Cruz, California, is discussed. Citizens attended forums and town meetings to suggest ideas for solving the community's energy problems. These ideas were then evaluated by the Energy Future Advisory Board and compiled into the Energy Future Plan. The energy plan covers such topics as new residences, residential retrofit, automobile efficiency, farm efficiency, commercial greenhouses, local food production, commercial efficiency, land use planning, energy education and financing, and solar, wind, and ocean energy. An energy implementation guide and glossary are included. Author (GRA)

N83-27481# Pacific Northwest Lab, Richland, Wash **PACIFIC NORTHWEST LABORATORY REPORT TO THE DOE OFFICE OF ENERGY RESEARCH. PART 2: ENVIRONMENTAL SCIENCES Annual Report, 1982**

C. M. NOVICH, ed Feb 1983 59 p refs 5 Vol.

(Contract DE-AC06-76RL-01830)

(DE83-007586; PNL-4600-PT-2) Avail: NTIS HC A04/MF A01

Progress in environmental sciences is reported. The following research areas are highlighted: terrestrial and riverine ecology; marine sciences; radionuclide fate and effects, ecological effects

of coal conversion, solid waste, mobilization fate and effects, and statistical and theoretical research

N83-27484# Pacific Northwest Lab, Richland, Wash **ECOLOGICAL EFFECTS OF COAL CONVERSION**

In its Pacific Northwest Lab Rept. to the DOE Office of Energy Res p 17-22 Feb 1983 refs

Avail NTIS HC A04/MF A01

The distributional kinetics, biological transformation, and ecological effects of complex organic materials after they are released to aquatic and terrestrial ecosystems were investigated. Potential for bioaccumulation and transfer through food chains leading to people is examined. It is indicated that coal liquids are more toxic than petroleum based fuel oils. The organic materials found in synthetic fuels and in other energy sources have a wide range of physical and chemical properties. Special methods of handling the materials presenting them to test systems, and analyzing their chemical composition are developed. The methods include chromatographic separations and identification of organic constituents of coal liquids, flow through aquatic bioassays, and hydroponic and lysimeter evaluation of plant exposures. Bioassays, behavioral testing, and microcosm studies, identify and assess organism and ecosystem and their response to stress and to the effects of complex hydrocarbons. DOE

N83-27489# Pacific Northwest Lab, Richland, Wash **TRANSFORMATION OF ENERGY-RELATED POLLUTANTS**

In its Pacific Northwest Lab Rept. to the DOE Office of Energy Res p 1-4 Feb 1983 refs

Avail NTIS HC A04/MF A01

Measuring chemical transformation rates of polycyclic aromatic compounds emitted by fossil-fueled power plants, correlating transformation rates of these compounds with distance from the source, ambient temperature, light intensity and concentrations of other reactant species, such as nitrogen oxides and ozone, and evaluating the results of laboratory studies on discrete reaction steps in the overall transformation processes and addressed. DOE

N83-27500# Argonne National Lab, Ill. Chemical Technology Div

SULFUR CONTROL IN FLUIDIZED-BED COMBUSTORS: METHODOLOGY FOR PREDICTING THE PERFORMANCE OF LIMESTONE AND DOLOMITE SORBENTS

D. C. FEE, K. M. MYLES, W. I. WILSON, L. S. FAN (Ohio State Univ.), G. W. SMITH, S. H. WONG, J. A. SHEARER, J. F. LENC, and I. JOHNSON Sep 1982 448 p refs Supersedes ANL/CEN/FE-80-10

(Contract W-31-109-ENG-38)

(DE83-007658, ANL/FE-80-10, ANL/CEN/FE-80-10) Avail

NTIS HC A19/MF A01

The ANL methodology which significantly simplifies predictions of sulfur capture in fluidized bed coal combustors is discussed. The use of the methodology predictions is summarized. The details of the method development and supporting data are given and comparisons between predicted sorbent performance and actual FBC plant data show to support the methodology. The method describes the experimental results and can be used with some confidence to compare sorbent performance, provided that the limitations of the methodology are recognized. DOE

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N83-27501# Argonne National Lab., Ill. Chemical Technology Div.

SULFUR CONTROL IN FLUIDIZED-BED COMBUSTORS: METHODOLOGY FOR PREDICTING THE PERFORMANCE OF LIMESTONE AND DOLOMITE SORBENTS. ADDENDUM. COMPILATION OF SORBENT PERFORMANCE DATA FROM ATMOSPHERIC FLUIDIZED-BED COMBUSTORS

D. C. FEE, K. M. MYLES, W. I. WILSON, L. S. FAN (Ohio State Univ.), G. W. SMITH, S. H. WONG, J. A. SHEARER, J. F. LENC, and I. JOHNSON Sep. 1982 99 p refs

(Contract W-31-109-ENG-38)

(DE83-007659; ANL/FE-80-10-ADD) Avail: NTIS HC A05/MF A01

Tabulated experimental data on sorbent utilization in fluidized bed combustors are measured. The data were extracted from a review of literature, dealing mainly with combustors greater than 18 in. in diameter. The tables include data on experimental variables, sorbent properties, coal properties, and the physical arrangement of the combustor. The format is designed to minimize the amount of data which must be entered for each experiment by making extensive use of libraries of the information, each common to many individual experiments. DOE

N83-27502# Oak Ridge National Lab., Tenn.

METEOROLOGICAL EFFECTS OF THERMAL ENERGY RELEASES (METER) PROGRAM Progress Report, Oct. 1980 - Sep. 1982

A. A. N. PATRINOS and H. W. HOFFMAN Mar. 1983 98 p refs

(Contract W-7405-ENG-26)

(DE83-008313; ORNL/TM-8603) Avail: NTIS HC A05/MF A01

This report examines the inadvertent weather modification effects of large cooling towers and cooling ponds. Emphasis was placed on field studies, and the focus of the program was on a precipitation modification study around the Bowen Electric Generating Plant in northwestern Georgia. The field effort includes the study of wetfall chemistry in the plant's vicinity. The analysis of three years of precipitation data have failed to show a significant effect of the plant on rainfall volume, the investigation of rainfall pattern variability has been inconclusive. The studies of wetfall chemistry have provided valuable information on the mechanisms of plume washout from large point sources and on the general characteristics of precipitation chemistry in the southeastern US. DOE

N83-27508# Argonne National Lab., Ill.

IMPLICATIONS OF EMERGING ENVIRONMENTAL-CONTROL TECHNOLOGIES FOR AIR-POLLUTION REGULATIONS

C. D. LIVENGOD, R. D. DOCTOR, P. S. FARBER, B. R. HUBBLE, J. A. LECKY, D. G. STREETS, and H. S. HUANG Nov 1982 62 p refs

(Contract W-31-109-ENG-38)

(DE83-005901; ANL/EES-TM-205) Avail: NTIS HC A04/MF A01

Control technologies applicable to coal fired energy systems are reviewed. Potential for improved emissions control or more economical control or both is noted to identify areas that may give rise to future ECT issues. The discussion is limited to technologies for control of sulfur dioxide (SO₂), nitrogen oxides (NO/sub x/), and particulate matter. The scope of the report is limited in several areas to what are the more promising technologies. DOE

N83-27511# PEDCO-Environmental Specialists, Inc., Cincinnati, Ohio.

ACID RAIN: CONTROL STRATEGIES FOR COAL-FIRED UTILITY BOILERS, VOLUME 1

M. SZABO, Y. SHAH, and J. ABRAHAM May 1982 104 p refs

(Contract DE-AC21-81MC-16361)

(DE83-006695; DOE/METC-82/42-VOL-1) Avail: NTIS HC A06/MF A01

An evaluation of the cost and effectiveness of conventional controls for emissions of sulfur oxides (SO/sub x/) and nitrogen oxides (NO/sub x/) from coal fired utility boilers is presented. The plant specific data can be used to verify other cost effectiveness models. The methodology and results of this evaluation have been used for review of assumptions and cost estimates. It is assumed that coal fired utility power plants in the midwestern United States are the major contributors to the acid rain problem in the Northeast. It is concluded that reducing SO/sub x/ and NO/sub x/ emissions from midwestern coal fired power plants may not significantly reduce the acidity of rain, even at the cost of billions of dollars for controls. Local sources of SO/sub x/ and NO/sub x/, chiefly oil fired boilers and automobiles in the Northeast, may contribute more significantly to the acid rain occurring there than previously realized. DOE

N83-27514# One America, Inc., Washington, D.C.

URBAN-WASTE PROGRAM RESEARCH AND DEVELOPMENT 1978-1981: AN OVERVIEW

Aug. 1982 93 p

(Contract DE-AC01-80CS-24312)

(DE82-019788; DOE/CS-24312/3) Avail: NTIS HC A05/MF A01

The DOE Urban Waste Program's research and development investments between Fiscal Year 1978 and the end of Fiscal Year 1981 are documented. The Sunset Review coverage is broadened and expanded by reviewing all the project literature available. The status of all R and D projects undertaken during the past four years is shown. The following are covered: historical perspective, mechanical technologies, thermal technologies, biochemical technologies, wastewater and water treatment technologies, and generic research and development. DOE

N83-27919# Committee on Appropriations (U. S. House).

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATION ACT, 1984

Washington GPO 1983 43 p H.R. 3133 enacted into law by the 98th Cong., 1st Sess., 6 Jun. 1983

Avail: US Capitol, Senate Document Room

Budget appropriations for the National Science Foundation, the National Aeronautics, and the Department of Housing and Urban Development-Independent Agencies are presented.

N83-27922# RAND Corp., Santa Monica, Calif.

AFTER ENERGY PRICE DECONTROL: THE ROLE OF GOVERNMENT CONSERVATION PROGRAMS

S. M. BESEN and L. L. JOHNSON Oct. 1982 61 p refs

(Contract DE-AC01-80PE-70269)

(RAND/N-1903-DOE) Avail: NTIS HC A04/MF A01

Energy conservation and price distortions, government intervention in response to price distortions, and the government role in a regime of correct prices are discussed. Author

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N83-27924*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
DOE/NASA AUTOMOTIVE STIRLING ENGINE PROJECT OVERVIEW '83

D G BEREMAND 1982 17 p refs Presented at the 18th Intersoc Energy Conversion Eng. Conf., Orlando, Fla., 21-26 Aug 1983

(Contract DE-AI01-77CS-51040)

(NASA-TM-83405, E-1683, NAS 1 15 83405,

DOE/NASA/51040-48) Avail NTIS HC A02/MF A01 CSCL 13F

An overview of the DOE/NASA Automotive Stirling Engine Project is presented. The background and objectives of the project are reviewed. Project activities are described and technical progress and status are presented and assessed. Prospects for achieving the objective 30% fuel economy improvement are considered good. The key remaining technology issues are primarily related to life, reliability and cost, such as piston rod seals, and low cost heat exchanges

Author

N83-27925*# Mechanical Technology, Inc., Latham, N. Y. Stirling Engine Systems Div.

AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Semiannual Technical Progress Report, 1 Jul. - 31 Dec. 1982

N. NIGHTINGALE, W. ERNST, A. RICHEY, M. SIMETKOSKY, G. SMITH, and M. ANTONELLI, ed. Jan. 1983 61 p

(Contract DEN3-32, EC-77-A-31-10040)

(NASA-CR-168074, NAS 1.26 168074, REPT-83-ASE-308-SA-3, SATPR-3) Avail NTIS HC A04/MF A01 CSCL 13F

Mod I engine testing and test results, the test of a Mod I engine in the United States, Mod I engine characterization and analysis, Mod I Transient Test Bed fuel economy, Mod I-A engine performance are discussed. Stirling engine reference engine manufacturing and reduced size studies, components and subsystems, and the study and test of low-cost casting alloys are also covered. The overall program philosophy is outlined, and data and results are presented.

J M S.

N83-27985# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

FUEL CONSERVATION EVALUATION OF US ARMY HELICOPTERS. PART 3: UH-1H FLIGHT TESTING Final Report, Feb. - Mar. 1981

F. STELLAR, D I UNDERWOOD, and F DOMINICK Aug 1982 84 p refs

(AD-A125667, USAAEFA-81-01-3) Avail NTIS HC A05/MF A01 CSCL 21D

The United States Army Aviation Engineering Flight Activity conducted level flight performance tests of the UH-1H helicopter to provide data to determine the most fuel efficient operating characteristics. Hot and cold weather test sites were used to extend the advancing tip Mach number data range to supplement existing YUH-1H performance data. Based on preliminary analysis, range can be increased significantly at optimum altitude and rotor speed compared to sea level and normal rotor speed (324 RPM). Rotor compressibility effects were significant at all test conditions

GRA

N83-28081# Kremen (Seymour S.) and Jhawan (Makhan), Coronado, Calif.

LOWER NET PRESSURE REVERSE OSMOSIS MEMBRANES AND SYSTEMS: COST AND PERFORMANCE ADVANTAGES AND LIMITATIONS Final Report

S S. KREMEN, C E. HULL, and M. JHAWAR Jun 1982 114 p refs

(Contract DI-14-34-0001-0491)

(PB83-150375, W83-01612, OWRT-C-00180-D(0491)(1)) Avail NTIS HC A06/MF A01 CSCL 07A

Reverse osmosis systems are generally designed and utilized on the basis of reference water flux and desalting performance at 400 psi net driving pressure (NDP). Membranes now being offered and tested at a preliminary commercial stage are capable of equivalent performance at 200 psi NDP. These membranes offer

immediately obvious savings in energy costs for reverse osmosis desalting and water reclamation. In addition, they can make a most important contribution to reduced membrane replacement costs and improved permeate quality when operating on high salinity feeds at higher recovery levels. A number of hypothetical cases were developed and tabulated, assuming a 200 psi NDP sea water membrane was available

GRA

N83-28158# California Univ., Los Angeles School of Engineering and Applied Science.

DESIGN EVALUATION AND APPLICATION OF CONTINUOUS FLOW CELLS FOR ORGANIC ELECTROCHEMICAL SYNTHESIS Progress Report

K NOBE 1982 27 p refs

(Contract DE-AC02-80ET-25207)

(DE82-012741, UCLA-ENG-P-5055-R-82) Avail NTIS HC A03/MF A01

The strategy of paired electrochemical synthesis for the production of organic chemicals can result in as much as a 50% reduction in energy consumption, as compared to conventional electroorganic synthesis. A continuation of the research in paired synthesis, presently being conducted in this laboratory, is proposed. The future proposed work includes (1) A continuing investigation into the chemistry of paired electroorganic reactions, (2) the engineering analysis and design of the electrochemical flow cell and separation equipment required for a synthesis, and (3) a bench scale pilot plant study and economic analysis of a synthesis

DOE

N83-28277# Tri-State Synfuels Co., Houston, Tex

TRI-STATE SYNFUELS PROJECT REVIEW. VOLUME 6: ENVIRONMENTAL, HEALTH, SAFETY AND SOCIOECONOMIC REVIEW

Jun 1982 702 p refs

(Contract DE-FC05-8104-20807)

(DE83-007539, DOE/OR-20807-T1-VOL-6) Avail NTIS HC A99/MF A01

Volume 6 includes site selection (National screening Powder River Basin, San Juan Basin, Illinois Basin, East Texas lignite belt, and North Dakota-Montana lignite belt, regional screening - 12 sites in Kentucky), environmental and socio-economic factors, land use, solid waste management, beneath and safety management, regulatory review, permit applications; meteorology, local government, transportation facilities, etc. Some of the surveys were quite detailed

DOE

N83-28589# TRW, Inc., McLean, Va. Energy and Environmental Div

COST AND ENERGY-EFFECTIVENESS OF CHEMICAL HEAT PUMPS FOR INDUSTRIAL PROCESS HEAT APPLICATIONS

W R STANDLEY In Courtesy Assoc., Inc. Proc of the DOE Phys and Chem Storage Ann Contractors' Rev Meeting p 21-25 Dec. 1982 refs

Avail: NTIS HC A25/MF A01

Cost and energy effectiveness of the sulfuric acid chemical heat pump (CHP) for recovering industrial waste heat and supplying useful process heat is assessed. A previous study of CHPs has indicated that the most effective application for the CHP technologies is very likely in the industrial sector. The current study expands on that conclusion by developing detailed analyses of the sulfuric acid CHP in specific industrial applications. The applications are selected to be recognizable to a broad audience of industrial energy managers and decision makers, and the analysis is conducted in such a manner as to present that audience with technical and economic parameters with which they are familiar

Author

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N83-28607# Argonne National Lab., Ill.
ICE PRODUCTION AND STORAGE FOR SEASONAL APPLICATIONS, UTILIZING HEAT PIPE TECHNOLOGY
 A. J. GORSKI and W. W. SCHERTZ In Courtesy Assoc., Inc. Proc. of the DOE Phys and Chem. Storage Ann Contractors' Rev. Meeting p 136-140 Dec. 1982 refs
 Avail NTIS HC A25/MF A01

The objective of this program is to characterize the technical features of formation, collection and storage of ice naturally grown during winter months by means of innovative heat pipe technology
 Author

N83-28641# American Society of Mechanical Engineers, New York
SMALL WIND POWER IN THE SOUTHWESTERN UNITED STATES
 G. P. TENNYSON 1983 13 p Presented at the Energy Sources Technol Conf. and Exhibition, Houston, Tex., 30 Jan - 3 Feb 1983

(Contract DE-AC04-76DP-00789)
 (DE83-005936, CONF-830108-2) Avail: NTIS HC A02/MF A01
 The Southwestern Great Plains agricultural production in both vegetable crops and cattle, and the extraction industries in oil and natural gas recovery both feed and power a significant percentage of our nation. Energy costs that are rising faster than the rate of return on the sale of these products are contributing to a serious situation with many farms being abandoned and oil wells being capped Wind energy, which is abundant in the region, is investigated as a near term applicable alternative energy sources
 DOE

N83-28667# Los Alamos Scientific Lab., N. Mex.
ELECTRIC-UTILITY OIL AND GAS USE IN THE EIGHTIES
 C. D. KOLSTAD, D. S. ABBEY, A. J. MARTINEZ, D. S. WILLIAMS, F. A. WOLAK, JR. (Harvard Univ.), and M. K. YEAMANS Apr. 1982 164 p refs
 (Contract W-7405-ENG-36)
 (DE82-015032; LA-9313-MS) Avail NTIS HC A08/MF A01

This report forecasts possible levels of oil and gas use by electric utilities in the US through 1990 The analysis is done at a regional level High and low levels of electricity demand as well as nominal and diminished availability of new generating capacity are assumed Projected oil and gas use for 1990 ranges from 1000 to 3200 barrels per day.
 DOE

N83-28668# Hawaii Univ., Manoa Natural Energy Inst.
RENEWABLE ENERGY IN HAWAII Progress Report
 M. TROY and N. E. BROWN Apr. 1982 28 p refs
 (DE82-905763, NP-2905763) Avail: NTIS HC A03/MF A01
 Renewable energy projects in Hawaii are reviewed as follows. geothermal energy, ocean energy, biomass, wind energy, direct solar energy, hydroelectric and other energy.
 DOE

N83-28699# Council of State Governments, Atlanta, Ga
A DEVELOPER'S GUIDE TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT IN THE SOUTHEAST
 S. DAY, H. GRANT, J. PAUKERT, G. HAGLER, and C. COUSINEAU, ed. Jun 1982 133 p
 (Contract DE-AC44-80R4-20004)
 (DE82-018722; DOE/R4-20004/T7) Avail NTIS HC A07/MF A01

Precise information is provided to small scale hydroelectric developers on the federal and state permitting processes in the eight states of Region IV of US Department of Energy, i.e., Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee The procedures for each permit are described in the text and flow charts are provided at the end of each chapter. Information is also included on state financing and taxation incentives which may apply to small hydro and on the public Utility Policies Act as it applies to small hydro.
 DOE

N83-28728# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, FEBRUARY 1982
 M. C. RUSSELL, P. RAGHURAMAN, and P. C. MAHONEY Jun. 1982 19 p refs
 (Contract DE-AC02-76ET-20279)
 (DE82-019336, DOE/ET-20279/206) Avail: NTIS HC A02/MF A01

Physical performance data obtained from photovoltaic energy systems under test are tabulated. Five prototype residential photovoltaic systems are under test, each of which consist of a roof mounted photovoltaic array sized to meet at least 50% of the annual electrical demand of an energy conserving house, and an enclosed structure to house the remainder of the photovoltaic system equipment, test instrumentation, and work space. In addition, one full sized photovoltaic residence, is also being monitored. A monthly summary presents a tabulation summarizing the monthly performance of the photovoltaic systems and monitored houses, as well as meteorological data. Then, an hour by hour tabulation of information is given for an average day of the month, including monitored house and prototype systems data
 DOE

N83-28730# Arizona Univ., Tucson Bureau of Geology and Mineral Technology.
GEOTHERMAL ENERGY IN ARIZONA Final Report
 C. STONE and J. C. WITCHER Sep. 1982 415 p refs
 (Contract DE-FC07-79ID-12009)
 (DE83-009343; DOE/ID-12009/T4) Avail. NTIS HC A18/MF A01

Current knowledge and basic data on geothermal resources in Arizona were compiled. The following are covered specific area investigations, thermal aspects of Arizona, and exploration methods
 DOE

N83-28745# Brown, Boveri und Cie, A.G., Heidelberg (West Germany). Zentrales Forschungslabor.
ABSORPTION HEAT PUMP FOR HEATING OF SMALL RESIDENTIAL BUILDINGS Final Report, May 1981
 H. BIRNBREIER, J. JESSINGHAUS, K. L. SAUER, and B. ZIEGENBEIN Bonn Bundesministerium fuer Forschung und Technologie Feb. 1983 131 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
 (BMFT-FB-T-83-011; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 27,50

A methanol/lithium bromide+zinc bromide absorption heat pump for heating one-and two-family residential buildings was developed. Thermodynamic data of the ternary mixtures with a molar ratio LiBr/ZnBr = 2:1 and 4:1 were obtained. A prototype unit (heating capacity 10 kW) was built and tested under all conditions occurring in a real heating system. For application in indirectly fired absorption heat pumps (generator temperature 100 C) a 4:1 mixture is favored Due to an excellent partial load behavior, the seasonal heat transfer factor is as high as 1.56. The stability of stainless steel and copper in ternary solution mixtures is sufficient
 Author (ESA)

N83-28747# Resource Transitions, Inc., Santa Cruz, Calif.
A CITIZENS' PLAN FOR ENERGY SELF-RELIANCE. THE PROCESS REPORT: HOW IT HAPPENED
 J. COHN and R. STAYTON 1982 16 p refs
 (PB83-136986; NSF/OSS-82005) Avail. NTIS HC A02/MF A01 CSCL 10A

Results are presented of a project undertaken to demonstrate that local action could meet the energy crisis in Santa Cruz, California, and to demonstrate that a community could cooperatively develop an energy plan for greater energy self reliance. Community participation took several forms neighborhood outreach; community education and involvement, and media and press coverage of the project. An advisory board was formed and research was undertaken to determine the feasibility of energy ideas generated

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in the neighborhoods and to answer questions posed by the advisory board. Selection criteria were developed for use in screening individual actions. Thirty programs with more than 120 actions were approved and a list of 16 priorities was established. Actions implemented by the Advisory Board are noted.

Author (GRA)

N83-28753# Los Alamos Scientific Lab, N. Mex
CLEAN AIR AND ENERGY: FROM CONFLICT TO RECONCILIATION

C. D. KOLSTAD, W. D. SCHULZE, and M. D. WILLIAMS (John Muir Inst for Environmental Studies, Napa, Calif) 1982 25 p refs Presented at Ann Meeting of the Am. Assoc. for the Advan. of Sci., Washington, D.C., 3 Jan 1982

(Contract W-7405-ENG-36)

(DE82-014057, LA-UR-82-1190, CONF-820118-7) Avail: NTIS HC A02/MF A01

Unconstrained energy resource development in the Rocky Mountain west is likely to threaten the environment and the health and well-being of the people. Impacts may be associated with visibility degradation, toxic concentrations of gases, and deposition of acidic or toxic substances. Because the possible benefits of energy development in the region are very large, there is great concern that constraints imposed by air quality regulation may preclude the use of important resources or make unduly expensive energy produced from the region. The conflict between energy and clean air in the region is exacerbated by non-energy sources, such as copper smelters and urban areas, that already pose significant environmental threats. The hard policy question is not how to preserve clean air resources or how to develop energy but how to achieve and balance both goals. The effects and regulatory costs and benefits of air pollution control are discussed, and policy directions to protect air quality while pursuing energy development are presented. DOE

N83-28757# Los Alamos Scientific Lab, N. Mex
REGIONAL AIR QUALITY IN THE FOUR CORNERS STUDY REGION

D. H. NOCHUMSON 1982 22 p refs Presented at the 75th Ann. Meeting on the Air Pollution Control Assoc., New Orleans, 20-25 Jun 1982

(Contract W-7405-ENG-36)

(DE82-011984; LA-UR-82-671, CONF-820627-2) Avail: NTIS HC A02/MF A01

The body of information presented in this paper is directed to policy makers, regulators, and energy planners concerned with the effect of energy development and alternative regulatory policies on regional air quality in the Four Corners Study Region. This study was one of 5 regional studies conducted for the National Commission on Air Quality (NCAQ). Potential regional air quality impacts were evaluated out to the year 1995 for alternative energy scenarios under current and alternative regulatory policies. Highlights of the results from the regional air quality analysis are discussed in this paper. DOE

N83-28758# Oak Ridge National Lab, Tenn. Environmental Sciences Div

GENERIC ENVIRONMENTAL ASSESSMENT REPORT FOR CONVENTIONAL FUEL-ALCOHOL PLANTS

J. L. ELMORE, E. D. WAITS, F. E. SHARPLES, D. B. HUNSAKER, JR., S. A. CARNES, M. SCHWEITZER, and J. F. MCBRAYER Aug 1982 134 p refs

(Contract W-7405-ENG-26)

(DE82-018187; ORNL/TM-7993, ESD-PUBL-1848) Avail: NTIS HC A07/MF A01

The environmental impacts of commercial scale fuel alcohol plants of conventional design are assessed. Commercial scale is defined as an annual production capacity of 60 x 10 to the 7th power to 6.0 x 10 to the 8th power L (16 x 10 to the 7th power to 1.6 x 10 to the 8th power gal). Conventional fuel alcohol plant use grains and sugar crops as feedstocks, dehydrate with benzene, ethylene glycol, ethyl ether, or gasoline, and use coal, natural gas, wood, or bagasse for process heat. Environmental controls

to limit impacts are readily available. The greatest potential impacts derive from liquid process waste streams, which have high biochemical oxygen demand (BOD) and possibly high metal concentrations, and from atmospheric emission arising from coal or biomass fired boilers. Both sources of emissions are regulated, and control technology exists to comply with those regulations. Impacts to the socioeconomic environment were assessed to be of concern only in the case of large plants in rural environments. DOE

N83-28760# Franklin Associates, Prairie Village, Kans
ESTIMATES OF AIR AND WATER POLLUTANTS AND ENERGY CONSUMPTION FROM THE PRODUCTION OF RAW MATERIALS USED IN WIND-ENERGY SYSTEMS

W. L. BIDER, L. E. SEITTER, L. E. BERTUGLIA, and R. G. HUNT Apr 1982 222 p refs Prepared for Midwest Research Inst., Golden, Colo.

(Contract EG-77-C-01-4042; DE-AC02-77CH-00178)

(DE82-015247; SERI/TR-09230-1) Avail: NTIS HC A10/MF A01

Data are presented which quantify the energy and environmental impacts associated with the manufacture of wind energy system components. The components are examined in terms of the basic materials used: steel, aluminum, copper, fiberglass, concrete and wood. Impact data quantify energy consumption, air and water pollutant emissions, solid waste generation, and transportation impacts per 1000 pounds of product made from each material. The detailed industrial process data from which total material impacts were calculated are appended for each material. DOE

N83-28762# Pennsylvania State Univ., University Park Dept of Chemistry

INSTRUMENTAL METHODS OF ANALYSIS OF SULFUR COMPOUNDS IN SYN-FUEL PROCESS STREAMS Quarterly Technical Progress Report, Jan. - Mar. 1982

J. JORDAN, J. STAHL, and J. YAKUPKOVIC Apr. 1982 19 p refs

(Contract DE-FG22-81PC-40783)

(DE82-016125, DOE/PC-40783/T6) Avail: NTIS HC A02/MF A01

Polysulfides were found to rearrange to longer average chain lengths during titration with p-hydroxymercuribenzoate (HMB). Such rearrangement was relatively rapid and reproducible for a given pH, producing tetrasulfide at pH 14. The reaction of cyanide and HMB was investigated, yielding approximate thermodynamic assignments. The literature on the voltammetry of the moieties S₂O₄(-2), S₂O₆(-2), S₃O₆(-2), S₄O₆(-2), S₅O₆(-2) is reviewed. These moieties exhibit different half wave potentials, on the basis of which speciation might be feasible. Analytically viable diffusion controlled currents were also reported for a majority of the moieties. Carefully controlled conditions are maintained (buffers, supporting electrolytes) in order to suppress anomalies (maxima, etc.) and obtain well defined limiting current domains. Total accounting of the sulfur balance in representative samples of syn-fuel progress streams is made. DOE

N83-28766# Texas Univ., Austin Bureau of Economic Geology

ENVIRONMENTAL BASELINE MONITORING IN THE AREA OF GENERAL CRUDE OIL-DEPARTMENT OF ENERGY PLEASANT BAYOU NUMBER 2: A GEOPRESSURED GEOTHERMAL TEST WELL, 1980 Annual Report

T. C. GUSTAVSON, R. C. HOWARD, and D. MCGOOKEY 1982 253 p refs

(Contract DE-AC08-79ET-27111)

(DE82-018119, DOE/ET-27111/7) Avail: NTIS HC A12/MF A01

Baseline air and water quality of the test well site, a summary of microseismic activity before and during 1980, and a description of the monitoring of a liquid tiltmeter at the test well site are described. DOE

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N83-28776# Energy and Environmental Analysis, Inc., Arlington, Va.

ASSESSMENT OF THE EFFECTS OF ACTIVE SOLAR THERMAL TECHNOLOGIES ON URBAN EMISSIONS Final Report, Sep. 1979 - Jul. 1980

Jan. 1983 112 p refs

(Contract EPA-68-03-2622)

(PB83-156927, EPA-600/7-83-008) Avail: NTIS HC A06/MF A01 CSCL 13B

Fuel displacement potential of solar technologies were analyzed to determine if the potential air quality benefits are significant enough to justify the promotion of solar commercialization as an air pollution control strategy. Fuel displacement by solar energy was found to be greatest in the residential water heating market and in electric end uses. However, the results suggest a limited role for solar energy in reducing air pollutant emissions. Emission reductions were relatively small, generally less than one percent. Generalizing these findings to the entire nation is cautioned against, since areas that were the most technically compatible with solar systems were not evaluated. Solar systems could readily be a viable emission reduction strategy in a specific case. GRA

N83-28778# University of Western Michigan, Kalamazoo. Dept of Chemistry

FUNDAMENTALS OF NITRIC OXIDE FORMATION IN FOSSIL-FUEL COMBUSTION Quarterly Progress Report, 29 Sep. - 28 Sep. 1981

T. HOUSER and M. E. MCCARVILLE May 1982 11 p refs

(Contract DE-FG22-810C-40805)

(DE82-016830; DOE/PC-40805/1, QPR-1) Avail: NTIS HC A02/MF A01

Kinetic and product distribution data was obtained using an atmospheric pressure flow system from which a mechanism for NO formation from the combustion of fuel nitrogen may be developed. The results of previous studies of the inert pyrolysis and oxidation of pyridine and of the oxidation of HCN and cyanogen are briefly discussed. HCN is the primary, volatile nitrogen containing intermediate formed during the combustion of fuel nitrogen, thus, this program is concerned with continuing the determination of the oxidation characteristics of HCN as well as those of pyridine. Several exploratory experiments were made determining the NO/sub x/ yields over wide ranges of concentrations (including CO and benzene as additives to HCN), temperatures and times. More complete measurements will be made after the new gas chromatograph is operational. DOE

N83-28907# Oak Ridge National Lab., Tenn. Transportation Energy Group.

DATA-BASED SIMULATOR FOR PREDICTING VEHICLE FUEL CONSUMPTION

A. B. ROSE, J. N. HOOKER, G. F. ROBERTS, and J. HODGSON (Tennessee Univ., Knoxville) 1982 40 p refs. Presented at the Soc. of Automotive Engr. Intern. Congr. and Exposition, Detroit, 22 Feb. 1982

(Contract W-7405-ENG-26)

(DE82-011524, CONF-820203-4) Avail: NTIS HC A03/MF A01

A hybrid system, combining on-road testing and statistical modeling, was developed which permits calculation of a vehicle's fuel consumption over any driving cycle. An instrumentation system permits collection of the necessary on-road and laboratory test data within a relatively short period of time and, once calibrated, the model requires considerably less CPU time for execution than engineering simulation models while providing results within 5% of on-road measured fuel uses. The model was run in conjunction with optimization routines for deriving minimum fuel use strategies for a variety of common driving maneuvers. Results for a 1979 Ford Fairmont wagon are given. DOE

N83-29412# Committee on Energy and Commerce (U. S. House).

METHANOL AS AN ALTERNATE TRANSPORTATION FUEL

Washington GPO 1983 302 p refs. Hearings before the Subcomm. on Fossil and Syn. Fuels of the Comm. on Energy and Com., 97th Congr., 2d Sess., 13 Aug. and 24 Sep. 1982

(GPO-12-626) Avail: Subcommittee on Fossil and Synthetic Fuels

Developments in the methanol industry are examined to identify barriers to market penetration and to assess policy options available to the Federal Government to promote the commercialization of methanol. Environmental concerns and problems of the petroleum and automobile industries are also discussed. A. R. H.

N83-29413# Committee on Energy and Commerce (U. S. House).

US SYNTHETIC FUELS CORPORATION AND NATIONAL SYNFUELS POLICY

Washington GPO 1982 72 p. Rept. presented by the Subcomm. on Fossil and Syn. Fuels of the Comm. on Energy and Com., 97th Congr., 2d Session, Jul. 1982. Proc. of a seminar held in Washington, D.C., 3 Feb. 1982

(GPO-96-481) Avail: US Capitol, House Document Room

The current status and policies of the United States Synthetic Fuels Corporation (SFC) were discussed. Also included were discussions on the current challenges facing the U.S. synfuels industry, environmental and industrial concerns regarding the emerging synfuels industry and the National Synfuels Policy. B. G.

N83-29441# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch

SUMMARY OF STATUS OF ENVIRONMENTAL PROTECTION AGENCY (EPA), OFFICE OF MOBILE SOURCES CHARACTERIZATION PROJECTS AS OF MARCH, 1982

T. M. BAINES Oct. 1982 63 p refs

(PB83-163972, EPA/AA/CTAB/PA/82-8) Avail: NTIS HC A04/MF A01 CSCL 21D

This report announces the assessment of Environmental Protection Agency (EPA) Office of Mobile Source Air Pollution Control (OMSAPC) work on regulated and unregulated emissions from a variety of current and prototype engines. Extensive work is underway investigating the influence of various fuels on light duty vehicle and heavy duty engine emissions. This work includes projects on alternate fuels such as methanol as well as fuels derived from coal or oil shale. Other projects include diesel engine characterization studies and evaluating aldehydes from high mileage catalyst equipped motor vehicles. GRA

N83-29442# Steam and Fuel Users' Association of India, Madras. Joint School Compound

PROCEEDINGS OF A NATIONAL SEMINAR ON ENERGY CHALLENGE OF THE EIGHTIES

Nov. 1981 181 p. Proc. held in Madras, 27-29 Nov. 1981

(PB83-164764) Avail: NTIS HC A09/MF A01 CSCL 21D

Energy is the ultimate factor in deciding the development of a country because every piece of equipment requires electrical energy as motive force. There is always a tremendous increase in demand as against the depleting nature of the conventional fossil fuels. There is now a remarkable global shift to coal from oil but that too cannot be the permanent solution. The proceedings contain the various papers presented at the seminar. A total number of 22 papers were presented. The broad subjects covered are Energy Recovery, Energy and Environment, Boilers, Water as a Source of Fuel, Role of Sugar Industry, Energy Conservation, and Energy Alternatives. GRA

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

N83-29478# Thermo Electron Engineering Corp., Waltham, Mass

GLASS BATCH PREHEATER, PHASE 3 Annual Report

Aug 1982 95 p refs

(PB83-167254, TE4229-383-82, GRI-82/001 2) Avail NTIS HC A05/MF A01 CSCL 13B

The glass industry uses 300,000,000 MMBtu annually, 50 percent of this energy is natural gas consumed in melting furnaces. A batch preheating system could reduce this energy use 20 percent (saving 30,000,000 MMBtu/yr) while simultaneously reducing the air pollution emissions. Results obtained in the first two phases indicated that a glass batch preheating system is feasible and that the resultant energy savings would pay for the additional equipment in less than a year. The major remaining concern was fouling of the distributor plate. Tests showed that deposits do build up in the heat exchanger. However, the deposits are extremely water soluble and easily cleaned off the plate with a water spray.

Author (GRA)

N83-29480# American Gas Association Labs., Cleveland, Ohio.
PULSE COMBUSTION RESIDENTIAL WATER HEATER Annual Report, Nov. 1980 - Oct. 1981

R J KOLODGY and G W LILJENBERG Sep 1982 52 p

(PB83-167221, GRI-80/0158) Avail NTIS HC A04/MF A01 CSCL 13B

A domestic water heater based on the pulse combustion principle was developed, thus significantly reducing natural gas costs for the residential consumer. With the cost of natural gas rising, it is important to develop fuel efficient residential appliances which are economically attractive to the consumer. The pulse combustion principle was proven to reduce fuel consumption significantly in residential furnaces and is expected to show similar results when applied to domestic water heaters. Direct venting, which is possible with pulse combustion burners, provides an additional economic benefit the consumer who elects to install a pulse combustion water heater and furnace in a new building will not require a chimney. GRA

N83-29724# Environmental Protection Agency, Ann Arbor, Mich Test and Evaluation Branch.

EMISSIONS AND FUEL ECONOMY OF THE KAT'S ENGINE BLOCK HEATER DEVICE

J MCCALL Oct 1982 14 p

(PB83-165548; EPA-AA-TEB-83-1) Avail NTIS HC A02/MF A01 CSCL 21G

The results of testing the Kat's Engine Block Heater with respect to exhaust emissions and fuel economy at ambient temperatures of 20 degrees, 40 degrees, and 60 degrees Fahrenheit are described. This device contains an electric heating element within an open metal cylinder which is spliced into the lower radiator hose of the engine's cooling system. The primary purpose of this device is to minimize hard starting in cold weather. A secondary purpose is to improve fuel economy. Testing of three 1979 passenger cars was conducted at EPA's Motor Vehicle Emission Laboratory from December 1981 through March 1982. The test sequence used was the Federal Test Procedure (FTP). GRA

N83-29807# Committee on Governmental Affairs (U S. Senate)

OVERSIGHT OF DEPARTMENT OF ENERGY RESEARCH AND DEVELOPMENT FACILITIES

Washington GPO 1983 138 p refs. Hearing before the Permanent Subcomm. on Invest. of the Comm. on Govt. Affairs, 97th Congr., 2d Sess., 27 Jul. 1982

(GPO-99-908) Avail. Permanent Subcommittee on Investigations

The management and administration of the research and development facilities are investigated. The internal procedural controls within these facilities and their oversight are assessed.

S.L.

N83-29818# Data Resources, Inc., Lexington, Mass

RESIDENTIAL DEMAND FOR ENERGY. VOLUME 1: RESIDENTIAL ENERGY DEMAND IN THE US Final Report

L D TAYLOR, G R. BLATTENBERGER, and R K RENNBACK Apr. 1982 180 p refs. Sponsored by EPRI

(Contract EPRI PROJ 1098)

(DE82-903277, EPRI-EA-1572-VOL-1) Avail NTIS HC A09/MF A01

Updated and improved versions of the residential energy demand models that are currently used in EPRI's Demand 80/81 Model are presented. The primary objective of the study is the development and estimation of econometric demand models that take into account in a theoretically appropriate way the problems caused by decreasing-block pricing in the sale of electricity and natural gas. An ancillary objective is to take into account the impact on electricity, natural gas, and fuel oil demands of differences and changes in the availability of natural gas. Econometric models of residential demand are estimated for all three fuel types using time series data by state. Price and income elasticities for a number of alternative models are presented.

DOE

N83-29820# Massachusetts Inst of Tech., Cambridge Energy Lab

EVALUATION OF THE ORNL RESIDENTIAL ENERGY-USE MODEL Interim Report

D MCFADDEN Jun 1982 153 p refs. Sponsored by EPRI

(Contract EPRI PROJ 1484)

(DE82-905768, EPRI-EA-2442) Avail NTIS HC A08/MF A01

The architecture, empirical foundation, and applications of the Oak Ridge National Laboratory (ORNL) Residential Energy Use Model are evaluated. A particular effort is made to identify the strengths and shortcomings of the model for alternative uses and to identify areas where model structure and empirical support could be upgraded. Concrete suggestions are made for improving model logic, strengthening the empirical basis for behavioral and technical parameters, and reducing the biases in the model that arise from aggregation. The overall conclusion is that the model has the potential to provide adequate forecasts, at a regional or national level, of the aggregate impacts of policies whose effects on households are relatively homogeneous. There are a number of model changes which would be relatively easy to implement and which should substantially improve forecasts of this sort. The version of the ORNL model reviewed here makes it fundamentally unsuitable for applications to geographical areas smaller than DOE regions or to policies that have a heterogeneous impact on households.

DOE

N83-29824# Department of Energy, Washington, D C Office of Market Analysis.

INTERNATIONAL ENERGY INDICATORS, FEBRUARY - MARCH 1982

E ROSSI, JR., ed. 1982 30 p

(DE82-014879; DOE/IA-0010/18) Avail NTIS HC A03/MF A01

Data are compiled and graphs are presented for: world crude oil production, 1974 to 1981; OPEC crude oil productive capacity; world crude oil and refined product inventory levels; 1975 to 1981; oil consumption in OECD countries, 1975 to 1981; USSR crude oil production and exports, 1975 to 1981; free world and US nuclear electricity generation, 1973-current capacity; US domestic oil supply, 1977 to 1981; US gross imports of crude oil and products, 1973 to 1981; landed cost of Saudi crude current and 1974 dollars; US coal trade, 1975 to 1981; US natural gas trade, 1975 to 1981; summary of US merchandise trade, 1977 to 1981, and energy/gross national product ratio.

DOE

N83-29879# Idaho National Engineering Lab., Idaho Falls.
SUMMARY AND RESULTS OF THE COMPREHENSIVE ENVIRONMENTAL MONITORING PROGRAM AT THE INEL'S RAFT RIVER GEOTHERMAL SITE

R. A. MAYES, T. L. THUROW, and L. S. CAHN 1982 12 p refs Presented at the DOE Environ. Protect. Infor. Meeting, Denver, 7 Dec. 1982

(Contract DE-AC07-76ID-01570)

(DE83-005583; EGG-M-29082; CONF-821215-13) Avail: NTIS HC A02/MF A01

The Raft River Geothermal Program was designed to demonstrate that moderate temperature geothermal fluids could be used to generate electricity and provide an alternate energy source for direct-use applications. The environmental program was initiated soon after drilling began. The major elements of the monitoring program were continued during the construction and experimental testing of the 5-MW(e) power plant. The monitoring studies established pre-development baseline conditions of and assessed changes in the physical, biological, and human environment. The Physical Environmental Monitoring Program collected baseline data on geology, subsidence, seismicity, meteorology and air quality. The Biological Environmental Monitoring Program collected baseline data on the flora and fauna of the terrestrial ecosystem, studied raptor disturbances, and surveyed the aquatic communities of the Raft River. DOE

N83-29937# Houston Univ., Clear Lake, Tex. Studies of the Future Program.

ASSESSING VERY LONG-RANGE IMPACTS FROM A RAPID CLIMATE CHANGE

O. W. MARKLEY and P. R. HALL 1982 49 p refs

(Contract DE-AC01-79EV-10021)

(DE82-017229, DOE/EV-10021/T1) Avail: NTIS HC A03/MF A01

A variety of anthropogenic, or human-generated forces are gradually changing global climate. These include effects due to slash and burn agriculture, industrial particulates, waste heat and gasses such as chlorofluoromethanes, nitrous oxide, and carbon dioxide. Although the short-range effects of these forces may seem to be relatively minor from a long-range perspective, climatologists warn that the long-range effects - especially of increases in atmospheric carbon dioxide resulting from widespread fossil fuel use will be great, bringing significant alterations in atmospheric temperature, wind and ocean currents, precipitation patterns, and other ecological phenomena. From a geological time perspective, the resulting climate changes will occur quite rapidly, and will affect human concerns in a number of ways. Besides being important for long-range social planning, these effects are of intrinsic interest to futures research and impact assessment methodologies. DOE

N83-30087# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.

MEASURES OF VALUE IN A LINEAR-PROGRAMMING MODEL OF THE US ENERGY SYSTEM

D. HILL 1982 18 p refs Presented at the Inst. for Management Sci./Operations Res. Soc. of Am. Joint Meeting, San Diego, Calif., 25 Oct. 1982

(Contract DE-AC02-76CH-00016)

(DE83-006685; BNL-32044; CONF-821012-4) Avail: NTIS HC A02/MF A01

The time phased linear program called MARKAL (Market Allocation) evaluates the merits of candidate new energy technologies in the 1980 to 2020 time period. Identical versions of the model were developed by DOE and the Federal Republic of Germany, using two different computer systems. Three types of objective functions were considered: total cost to the nation of the energy system, discounted to a present value; oil imports during the 45 year time frame; and a cost consisting of the sum the total cost times a factor of the total oil imports. This factor is basically the extra market cost per unit of oil imports or as a subcharge. Computer runs are evaluated for sixteen scenarios. DOE

N83-30236# Committee on Science and Technology (U. S. House)

FUSION ENERGY WORKSHOP

Washington GPO 1982 161 p Joint hearing before the Subcomm. on Energy Res. and Production of the Comm. on Sci. and Technol. and the Subcomm. on Energy Res. and Develop. of the Comm. on Energy and Nat. Resources, 97th Congr., 2nd Sess., No. 176, 8 Sep. 1982

(PUBL-97-128; GPO-12-821) Avail: Subcommittee on Energy Research and Production

Technology and public policy related to magnetic fusion research and development in the United States are discussed. Physics issues which must be addressed are identified and examined. International cooperation and the types of reactors being developed in other countries are considered as well as program characteristics, risk levels, and management approaches in the United States. A R. H.

N83-30316# Tulsa Univ., Okla. Dept. of Chemical Engineering.
ENVIRONMENTAL ASSESSMENT DATA BASE FOR PETROLEUM REFINING WASTEWATERS AND RESIDUALS
Final Report, Jun. 1978 - Jun. 1981

F. S. MANNING and E. M. SNIDER Feb. 1983 242 p refs

(Contract EPA-R-805099)

(PB83-164749, EPA-600/2-83-010) Avail: NTIS HC A11/MF A01 CSCL 05B

A Peer-Group Review Committee was established to provide direction to the project and to ensure that a diversity of viewpoints was considered. Four comprehensive state-of-the-art reviews, by outside consultants were prepared. The four individual state-of-the-art reviews were critically examined and eight areas where further research was considered necessary to improve the data base were selected. GRA

02

SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators

A83-30153

FUNDAMENTALS OF SOLAR ENERGY CONVERSION

E. E. ANDERSON (Nebraska, University, Lincoln, NE) Reading, MA, Addison-Wesley Publishing Co, 1983, 653 p. refs

This textbook strives to strengthen a student's knowledge of the basic sciences as well as to provide a practical background in solar energy conversion. Particular consideration is given to solar geometry, the availability of solar energy, solar concentrators, elements of fluid mechanics and heat transfer in solar systems, flat-plate collectors, and thermal storage of solar energy. The use of solar energy for specific types of loads is then discussed. The application of active solar systems to space and hot-water heating is considered, and a description is given of the empirical f-chart method for thermal-performance analysis. The economics of solar systems is examined along with the application of solar energy to cooling and dehumidification loads as well as the application of solar energy to industrial and other thermal loads. The concept of passive systems is explained, and the evaluation of thermal performance on the basis of the empirical load/collector ratio method is described. Appendixes are presented with such information as solar-position charts, tables of solar radiation and climatic data, and programs for hand-held calculators. B. J.

A83-30186*# National Aeronautics and Space Administration, Washington, D. C.

SUMMARY ASSESSMENT OF THE SATELLITE POWER SYSTEM

F C SCHWENK (NASA, Solar Terrestrial Systems Office, Washington, DC) (Energy to the 21st century, Proceedings of the Fifteenth Intersociety Energy Conversion Engineering Conference, Seattle, WA, August 18-22, 1980. Volume 2, p 1375-1381) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p 193-199 refs

Previously cited in issue 21, p 3922, Accession no. A80-48353

A83-30205

EFFICIENCY OF LUMINESCENCE IN LUMINESCENT SOLAR CONCENTRATORS

A LEMPICKI (GTE Laboratories, Inc., Waltham, MA) Applied Optics (ISSN 0003-6935), vol 33, April 15, 1983, p 1160-1164. Research supported by the Binational Industrial Research and Development Foundation of Israel refs

The power efficiency of luminescence excited by solar radiation in luminescent solar collectors is calculated for a glass sheet doped with Cr(3+) The achievable chemical potential for an optically thick absorber irradiated by diluted blackbody radiation as a function of Cr(3+) concentration, sheet thickness, sunlight dilution, and luminescence quantum yield leads directly to overall conversion efficiency of solar power to luminescence power.

Author

A83-30212

UNIFORM AND GRADED MULTILAYERS AS X-RAY OPTICAL ELEMENTS

P. LEE (Ball Corp., Aerospace Systems Div., Boulder, CO) Applied Optics (ISSN 0003-6935), vol 33, April 15, 1983, p 1241-1246 refs

A detailed comparison of the performance of uniform and graded multilayers as soft X-ray monochromators and normal incidence collectors has been made In particular, the responses of flat depth, and laterally graded multilayers to Al K-alpha radiation, wavelength 8 34 A, have been computed and compared with the corresponding uniform multilayer. Furthermore, the efficiency of graded and uniform multilayers as normal incidence X-ray collectors has been calculated in terms of effective areas for parabolic reflectors tuned to the O K-alpha line, wavelength 23 7 A Finally, the effective areas of four strong solar emission lines in the 30-60 A region have been computed for uniform multilayers. Normal incidence multilayer mirrors are well suited for spectroheliograph type of applications

Author

A83-30270

THE EFFICIENCY OF A GRADED-BAND-GAP SOLAR CELL [EFFEKTIVNOST' VARIZONNOGO SOLNECHNOGO FOTOELEMENTA]

A S VOLKOV, M. B KERIMI, A BERKELIEV, and P G ZAVIALOV (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Instiut, Ashkhabad, Turkmen SSR) Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk (ISSN 0002-3507), no 6, 1982, p 34-39 In Russian refs

An analytical study is presented of the energy conversion efficiency of a graded-band-gap p-n structure where the forbidden band width $E_{sub g}$ varies nonlinearly with the x coordinate The whole region of the nonlinear variation of the forbidden band width is divided into three areas, where $E_{sub g}(x)$ is almost linear, in order to determine the distribution and flux density of nonequilibrium charge-carriers in each of these areas This division makes possible a broad analytical study of the dependence of the internal energy conversion efficiency on the absolute value of $E_{sub g}$ on the illuminated surface of the structure and inside the structure Formulas are derived which can be used to determine optimal variants of solar cells based on arbitrary graded-band-gap semiconductors

B.J

A83-30847

HIGH PERFORMANCE COLLECTORS

H OGAWA, S HOZUMI, T MITSUMATA, K YOSHINO, S. ASO, and K EBISU (Matsushita Electric Industrial Co., Ltd., Energy Conversion Research Laboratory, Osaka, Japan) Energy Developments in Japan (ISSN 0161-8091), vol 5, April 1983, p 395-409

Materials and structures used for flat plate solar collectors and evacuated tubular collectors were examined relative to their overall performance to project effectiveness for building heating and cooling and the feasibility of use for generating industrial process heat Thermal efficiencies were calculated for black paint single glazed, selective surface single glazed, and selective surface double glazed flat plate collectors The efficiencies of a single tube and central tube accompanied by two side tube collectors were also studied Techniques for extending the lifetimes of the collectors were defined The selective surface collectors proved to have a performance superior to other collectors in terms of the average annual energy delivered Addition of a black chrome-coated fin system to the evacuated collectors produced significant collection efficiency increases

M.S.K

A83-30849

RECENT DEVELOPMENTS IN CENTRAL RECEIVER SYSTEMS

A SKINROOD (Sandia National Laboratory, Livermore, CA) Sunworld (ISSN 0149-1938), vol 6, Aug 1982, p 98-101

A development status report is given for high temperature solar thermal central receiver projects currently underway, with attention to design features, construction schedules, operation and maintenance cost projections, and performance predictions and evaluations The projects include Eurelios, in Sicily, with a 1 MW(e) power rating, which has been designed and built by a consortium of Italian, French, and German companies, the Themis plant in southern France, with 2 MW(e) output, which has been funded by the French government, the Japanese Project Sunshine on the Island of Shikoku, the U S 10 MW(e) pilot plant at Barstow, CA, and two installations already operating in southern Spain Attention is given to heat transfer fluid and thermal energy storage systems and substances

O.C

A83-30850

TESTING THE EFFICIENCY OF SOLAR COLLECTORS AT THE TECHNICAL UNIVERSITY OF DENMARK

C BISGAARD (Hong Kong Polytechnic, Kowloon, Hong Kong) and S SVENDSEN (University of Hong Kong, Hong Kong) Sunworld (ISSN 0149-1938), vol. 6, Aug 1982, p 114-117 refs

A solar efficiency testing simulator is presented which consists of 36 1 kW lamps placed in a frame which directs their beams toward a solar collector test rig A closed circuit fluid circulation system is connected to the collector, and air flow over the collector is simulated by means of a cross flow fan Efficiency is determined at four different temperature levels of the fluid, spread at equal intervals between ambient air temperature and 100 C A solar irradiance of 800 W/sq m is simulated Typical test results are presented

O.C.

A83-31526* Jet Propulsion Lab., California Inst of Tech., Pasadena.

SOLAR SALT POND POTENTIAL SITE SURVEY FOR ELECTRICAL POWER GENERATION

M. G. HURICK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN Enhancement of quality through environmental technology, Proceedings of the Twenty-eighth Annual Technical Meeting, Atlanta, GA, April 21-23, 1982 Mt Prospect, IL, Institute of Environmental Sciences, 1982, p 227-235. Research sponsored by the U S Department of Energy refs

A solar salt gradient pond acts as a passive heat sink or thermal battery in which energy can be recovered through the conversion of thermal energy into electrical energy Here, a condensation of a larger report that focused on the identification of potential salt gradient pond sites in the United States using in-situ resources is presented. It is shown that there are at least 24 states that lie in a primary or secondary potential site category.

Fourteen states are assigned as primary states and ten are assigned as secondary. The division is subjectively based on the severity of winter weather. The most promising states are those that lie in the southern half of the country. When the primary and secondary category states are combined with the other states that may be able to support a pond, a total of 38 states exhibit the possibility of supporting power generation sites of various size. V.L.

**A83-31598
HIGH TEMPERATURE SOLAR ELECTROTHERMAL
PROCESSING - ZINC FROM ZINC OXIDE**

E. A. FLETCHER and J. E. NORING (Minnesota, University, Minneapolis, MN) *Energy* (UK) (ISSN 0360-5442), vol. 8, April 1983, p. 247-254 refs
(Contract N00014-82-K-0523)

**A83-31600
THE SOLAR RADIATION RESOURCE**

A. RABL and F. VON HIPPEL (Princeton University, Princeton, NJ) *Energy* (UK) (ISSN 0360-5442), vol. 8, April 1983, p. 295-316. Research supported by the Solar Energy Research Institute and Ford Foundation. refs

The characteristics of solar radiation which are most useful for the assessment of solar technologies. Graphs are presented which show the total annual insolation incident on the principal tracking and non-tracking collectors are discussed. Additional graphs are developed for the latitudinal and seasonal variations of solar radiation in the absence of an atmosphere. These are then compared with measurements averaged over the U.S. SOLMET sites to provide an understanding of the role of atmospheric effects on the seasonal variations of solar radiation. Author

**A83-31609
GEOMETRIC CONFIGURATION FACTORS FOR POLYGONAL
ZONES USING NUSSELT'S UNIT SPHERE**

F. W. LIPPS (Houston, University, Houston, TX) *Solar Energy* (ISSN 0038-092X), vol. 30, no. 5, 1983, p. 413-419. Research supported by the Maschinenfabrik Augsburg-Nürnberg AG. refs

Computer implementation of Nusselt's number for defining the configuration factors for triangular and quadrilateral zones in a solar cavity receiver to minimize losses is presented. The configuration integral is formulated, noting that use of Nusselt's projection ameliorates the problem of edge contact by reducing the defining integral to a double integral over a bounded integrand. Numerical methods can then be applied to obtain a solution. A FORTRAN routine called NUSSELT is outlined and results of calculations for a six-sided figure are compared, with results yielded by Sparrow's (1965, 1966) method, which is based on a double contour integral. The NUSSELT code is found to be adequate for engineering applications, while Sparrow's method is more versatile. M S K

**A83-31610
USE OF POLYMERIC MATERIALS IN THE ASSEMBLY OF
SOLAR CELLS**

A. ADDEO, V. BONADIES, C. CARFAGNA, G. GUERRA, A. MOSCHETTI (Istituto G. Donegani, Naples, Italy), and L. NICOLAIS (Napoli, Università, Naples, Italy) *Solar Energy* (ISSN 0038-092X), vol. 30, no. 5, 1983, p. 421-424. Research supported by the Consiglio Nazionale delle Ricerche and European Economic Community. refs

A new photovoltaic module made of solar cells encapsulated in polymeric matrices is described. The encapsulation system utilizes polymers of the acrylate family which have different thermal and mechanical properties. Preliminary physical characterization of these systems suggest that these materials can economically encapsulate photovoltaic modules. Author

**A83-31614
ENHANCEMENT OF RADIATION COOLING BY MEANS OF
REFLECTORS**

M. S. MARREIROS (Lisboa, Instituto Superior de Engenharia, Lisbon, Portugal) and R. ROSA (Laboratório Nacional de Engenharia e Tecnologia Industrial, Sacavem, Portugal) *Solar Energy* (ISSN 0038-092X), vol. 30, no. 5, 1983, p. 463-471. refs

The coupling of optical concentration and reflectivity for radiative cooling is analyzed. Attention is given to the specific case of a compound parabolic concentrator (CPC) which concentrates the incoming radiation into an exit aperture and also limits the amount of incoming radiation. An analytical model is developed for radiative cooling by a radiator coupled to a reflector, with the CPC trough being truncated at the bottom. The concentration ratio and acceptance function of the CPC are calculated, and minimum values for a normalization constant and the concentration are found. The coupling of the reflector to the radiator is shown to provide a performance that is higher than that available with a radiator alone. Any reflector will improve radiator performance. Finally, it is demonstrated that the CPC-radiator configuration will perform satisfactorily in Portugal. M S K.

**A83-31845
THE USE OF METEOSAT FOR SOLAR RADIATION MAPPING**

C. DELORME (Compiègne, Université Technologie, Compiègne, Oise, France), J. AMADO, and P. RABERANTO (Groupeement pour le Developpement de la Teledetection Aerospatiale, Toulouse, France) *Meteorologische Rundschau* (ISSN 0026-1211), vol. 36, April 1983, p. 41-49. refs

A method to compute solar flux reaching the ground from numerical data of geostationary satellite METEOSAT is described. Only the visible channel is used. A clear sky brightness is determined for each pixel. Three thresholds allow to distinguish four solar radiation transmission factors corresponding to four cloud classes. Some preliminary results are compared with hourly ground measurements in Africa and discussed. Author

**A83-32041
A REGENERATIVE AEROBIC PHOTOELECTROCHROMIC
CONVERTER [AEROBICHESKII FOTOELEKTROKHIMICHESKII
PREOBRAZOVATEL' REGENERATIVNOGO TIPA]**

V. M. ARUTIUNIAN and T. A. VARDAPETIAN (Erevanskii Gosudarstvennyi Universitet, Yerevan, Armenian SSR) *Geliotekhnika* (ISSN 0130-0997), no. 2, 1983, p. 3-7. In Russian. refs

Aerobic photoelectrochemical converters of solar energy operate in the presence of oxygen or hydrogen, which can be evolved inside the cell or supplied from outside. Regeneration of the initial electrolyte is assured by reduction of oxygen into water on the cathode and oxidation of water on the anode. The characteristics of converters operating in the regenerative aerobic mode are compared to the characteristics of converters operating in the water-photolysis mode. In addition, typical volt-ampere characteristics are presented for a regenerative aerobic converter for a light intensity of 150 mW/sq cm. Results show that in a number of cases the aerobic converters can be more efficient than homogeneous photolytic converters. B.J.

**A83-32046
ON THE POSSIBILITY OF SOLAR-RADIATION STORAGE IN
ORGANIC PHOTOISOMERS [O VOZMOZHNOSTI
AKKUMULIROVANIIA SOLNECHNOGO IZLUCHENIIA V
ORGANICHESKIKH FOTOIZOMERAKH]**

S. N. TRUSHEVSKII, S. S. IAROVOL, N. S. ZEFIROV, P. P. SIDOROV, M. I. GAIDAR, and M. V. PROSKURINA (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) *Geliotekhnika* (ISSN 0130-0997), no. 2, 1983, p. 21-24. In Russian. refs

It has been shown that photochemical valence isomerization in organic photoisomers can be used to achieve a specific stored energy up to 1300 kcal/kg. Theoretical calculations show that the efficiency of photochemical storage units can attain 90 percent with respect to the active part of the solar spectrum. Thus, in

02 SOLAR ENERGY

principle photochemical processes are compared in terms of efficiency and capacity with the better known techniques of solar energy storage. Examples of photochemical transitions occurring with energy absorption are examined. B.J

A83-32047

MULTISECTION PLANAR FOCUSING LENSES AS CONCENTRATORS OF SOLAR RADIATION [MNOGOSEKTSIONNYE PLOSKIE FOKLINY KAK KONTSENTRATORY SOLNECHNOGO IZLUCHENIYA]

V. A. GRILIKHES and O. F. ZAITSEV. *Geliotekhnika* (ISSN 0130-0997), no. 2, 1983, p. 25-29. In Russian. refs

An analysis is presented of the energy and geometric characteristics of planar focusing lenses with single reflection and an unlimited number of sections. These devices are compared with low-potential concentrators of other types, and preliminary practical recommendations on the application of focusing-lens concentrator systems are presented. It is shown that the minimum depth of the focusing lens (for arbitrary values of the degree of concentration) is achieved at an angle of inclination of the first section of approximately 60 deg, which angle should be considered optimal. The relative depth is studied as a function of the energy coefficient of concentration for focusing lenses with plane multisection surface at an angle of inclination of 60 deg, focusing lenses with multiple reflection, and parabolocylindrical focusing lenses. B.J

A83-32048

THE COMBINATION OF HOLLOW FOCUSING CONCENTRATORS WITH FIBER-OPTIC WAVEGUIDES [SOCHETANIE POLYKH FOKONOV S VOLOKNISTYMI SVETOVODAMI]

V. K. BARANOV. *Geliotekhnika* (ISSN 0130-0997), no. 2, 1983, p. 29-33. In Russian.

The use of hollow focusing concentrators (focons) together with fiber-optic waveguides in systems for the transmission of concentrated solar energy is considered. Different variants of the combination of fiber-optic waveguides with hollow single and double focons are examined, and limiting values of the coefficient of geometric concentration produced by focons in conjunction with fiber-optic waveguides are determined. Optical systems in which fiber-optic waveguides are used in conjunction with hollow (especially double) focons are shown to be feasible. In such systems, however, the focon parameters must correspond to the numerical aperture and diameter of the waveguide. B.J

A83-32176

PHOTOVOLTAIC SOLAR ENERGY CONFERENCE; PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE, STRESA, ITALY, MAY 10-14, 1982

W. H. BLOSS, ED (Stuttgart, Universitaet, Stuttgart, West Germany) and G. GRASSI (Commission of the European Communities, Brussels, Belgium). Conference sponsored by the Commission of the European Communities. Dordrecht, D. Reidel Publishing Co., 1982, 1138 p. In English, French, and Italian.

The state-of-the-art in photovoltaic (PV) systems and components were assessed, experimental activities were described, cost reduction measures were outlined, and future directions for PV research, applications, and market growth were investigated. Attention was given to thin film, crystalline, and amorphous Si solar cells, and to the level of funding devoted to PV research by various governments. Small-scale remote island and village installations were cited as the current market, although larger arrays are being built to interface with national utility grids. The production of continuous run CdS cells of 1 sq cm area with 7.5 pct efficiency was reported, together with 8 pct efficiency heterojunction cells and 22 pct efficient AlGaAs/GaAs cascade cells at 103 suns concentration. Developments in point focus, Fresnel lens, and fluorescent concentrator systems were reported. M.S.K.

A83-32177

OVERVIEW OF THE EUROPEAN COMMUNITY'S ACTIVITIES IN PHOTOVOLTAICS

W. PALZ (Commission of the European Communities, Brussels, Belgium). IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 3-8.

The Commission of the European Communities is currently implementing a comprehensive programme on photovoltaics. This programme includes basic R+D work, module testing, development of pilot projects, demonstration projects and applications in developing countries. Particular attention is being paid to the development of expertise and production capabilities in industry and to strengthening cooperation between the various European countries. Author

A83-32178

THE ITALIAN PROGRAMME IN PHOTOVOLTAIC SOLAR ENERGY

U. FARINELLI (ENEA-National Committee for Research and Development of Nuclear and Alternative Energies, Rome, Italy). IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 9-12.

Italian programs and goals for developing a photovoltaic (PV) industry and market are outlined. It is suggested that only a few megawatts of PVs will be produced for domestic consumption in the next few years, while the largest market is for developing nations where costly diesel-fueled generators are used. The installation of PV systems in developing areas will permit testing and scaling up of production capacities from several MW to several hundred MW and then to GW annual production. Approximately 55,000,000 was devoted to government research in PV in 1982 and a PV research laboratory is being built near Naples. M.S.K.

A83-32179

UNITED STATES FEDERAL PHOTOVOLTAIC PROGRAM STATUS

M. B. PRINCE and A. L. BARRETT, JR (U.S. Department of Energy, Photovoltaic Energy Technology Div., Washington, DC). IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 20-27.

Program features of the DoE R and D efforts to increase the efficiency and stability of photovoltaic (PV) systems are outlined, including cooperative work with European organizations. The minimum goals for laboratory-scale devices are a 10 pct efficiency, reproducibility, stability, and potential for low cost production. Research is carried out on thin film materials, multi-bandgap cells, concentrators, the physics of amorphous materials and electrochemical mechanisms, and metrology of surface and subsurface properties. Cost thresholds considered as satisfactory are \$0.70/Wp for Si materials and \$0.40/Wp for non-Si systems. Work is proceeding with the European community to establish performance criteria and standards, consultation for design review, and arrangements for formal visits between government officials, scientists, and industrial managers. M.S.K.

A83-32180

APPLICATION TRENDS FOR PHOTOVOLTAICS

H. L. MACOMBER (Monegon, Ltd., Gaithersburg, MD). IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 30-39.

This paper presents the results of studies by MONEGON to develop forecasts of PV system application markets. These forecasts consider economic factors such as conventional energy costs now and in the future, the relationship between world economic conditions, as represented by each country's Gross National Product, and energy demand; the cost potential for PV systems technologies; and the application trends in the past and future. The application sectors analyzed are remote, stand-alone systems; residential systems;

service/commercial/industrial/institutional, and central utility systems. An overall market forecast is developed and this forecast is segmented into the four market sectors. Author

A83-32181

THE POTENTIAL FOR PHOTOVOLTAICS IN EUROPE

M. R. STARR (Sir William Halcrow and Partners, Swindon, Wilts., England) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 40-50. Sponsorship: Commission of the European Communities refs (Contract CEC-ESC-P-049-81-UK(H))

The economics, the potentials for cost reductions, and the markets for photovoltaics (PV) in Europe are summarized. Cost reductions depend on advances in solar grade Si production, in ribbon technologies, improvements in wafer cutting techniques, development of CdS thin film technology, and progress in amorphous Si cell processes. The price of a peak Watt is projected to decrease from \$9.09 to the \$0.51-\$2.02 range by the year 2000, with the assumption of successful construction of plant producing from 50-100 MW of cells annually. PV systems are expected to produce power at rates lower than those from small diesel generators in remote areas by the late 1980s. The sales of small-scale units of several kWp are projected to reach 100,000 arrays annually by 1995 for residential applications and 50,000 units annually for 150 kWp industrial installations. M.S.K.

A83-32182

THE BEHAVIOUR OF LARGE SOLAR POWER STATIONS IN THE SWISS ALPS

M. REAL (Eidgenössisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 51-56. refs

Performance results with scale model and full size solar cell arrays installed in alpine conditions for the generation of grid-compatible power are discussed. The Swiss Alps have been surveyed to reveal a potential of 160 sq km of potential large-scale photovoltaic array (PV) sites. The test program was performed to examine the capability of continued PV operations in severe alpine winters. The scale model array was found to accurately match the snow and ice accumulation recorded by time lapse photography of the in situ array. It is recommended that the support legs of the arrays be painted black to augment the solar heating for the support frame to help keep the modules free of ice and snow. The actual loss of efficiency during the severest weather was determined to be 5 pct of array output. M.S.K.

A83-32183

DESIGN, INSTALLATION, AND INITIAL PERFORMANCE OF 350-KW PHOTOVOLTAIC POWER SYSTEM FOR SAUDI ARABIAN VILLAGES

F. HURAI, B. KHOSHAIM, A. AL-SANI (Midwest Research Institute, Kansas City, MO), M. S. IMAMURA, and A. A. SALIM (Martin Marietta Aerospace, Denver, CO) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 57-66.

Design and performance features of the 350 kWp solar cell array power plant in Saudi Arabia, erected as part of the SOLERAS program, are described. The array covers a 230 x 290 m area with tracking units of 256 Si cells and 32 Fresnel lenses on each unit. The entire system is coupled to a 1 MW diesel back-up generator in order to ensure power for several villages which are not near a utility grid. A lead-acid battery storage system is included to keep 1700 Ah of power in reserve. The array produced an averaged 280-320 kWp output during tests with an overall efficiency of 9-10.5 pct. The control system assures full battery charge at the end of the day, and the inverter has operated at over 94 pct efficiency at a 250 kW load. It is noted that the entire project was designed, modules manufactured, and installation achieved within 1.5 yr. of contract signing. M.S.K.

A83-32185

ADVANCED SYSTEM DESIGN FOR SOLAR POWER PLANTS

V. CORDES and K. H. KORUPP (Telefunken AG, Wedel, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 89-93.

The state-of-the-art in applied photovoltaic (PV) systems and system subcomponents is assessed. The control systems vary from microcomputers in large installations to analogous control units and simpler systems with increasingly less output. Module wiring and various module connection techniques are reviewed, including the usage of shunt diodes to isolate malfunctioning modules. Junction boxes and plug connections are cited as the most economic connection technique. Charge regulators are required to match the gassing voltage threshold with the temperature of the lead-acid batteries to optimize the charging as well as to introduce a delay in the protective circuit against overdischarge. Inverters are necessarily matched to the load, and several types are discussed. M.S.K.

A83-32186

THE MISSISSIPPI COUNTY COMMUNITY COLLEGE LARGE-SCALE DEMONSTRATION PROJECT A SUCCESS STORY

H. V. SMITH (Mississippi County Community College, Blytheville, AR) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 94-96.

A83-32187

15 KW EXPERIMENTAL PHOTOVOLTAIC SOLAR POWER PLANT

M. CAMANI (Dipartimento dell'Ambiente, Bellinzona, Switzerland), D. BOZZOLO, O. DALDINI, R. PAMINI, G. SALVADE, F. SOLCA, C. SPINEDI, F. ZAMBONI (Laboratorio di Fisica Terrestre, Canobbio, Switzerland), T. CELIO (Ufficio d'Ingegneria per l'Elettrotecnica, Ambri, Switzerland), and C. GIOVANNINI (Invertomatic, Locarno, Switzerland) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 97-100. Research supported by the Nationaler Energie-Forschungs Fonds, Societa Elettica Sopracenerina, and Migros-Genossenschafts-Bund.

TISO 15 is an experimental, utility line interactive photovoltaic installation. It is intended for the collection of practical data related with the direct immission of photovoltaic electrical energy into a standard AC utility grid. A flat-plate array subfield provides the electrical power to a 10 kW inverter interacting with the local mains. A second array subfield (5 kW) with flat-concentrating modules and a separate inverter will be installed later on this year. Author

A83-32188

PHOTOVOLTAIC RETROFIT FEASIBILITY IN THE UNITED STATES

J. L. JACKSON (Sandia National Laboratory, Albuquerque, NM) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 101-105. Research supported by the U.S. Department of Energy refs

A83-32189

EXPERIMENTS ON COMBINED PHOTOVOLTAIC-AEOLIAN ELECTRIC GENERATION IN A RESIDENTIAL STAND-ALONE SYSTEM

P. U. CALZOLARI (Bologna, Università, Bologna, Italy), G. C. CARDINALI, A. GARULLI, D. NOBILI, and A. ZANI (CNR, Istituto LAMEL, Bologna, Italy) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 106-110.

A83-32190

ALICUDI PROJECT

V. ARCIDIACONO, S. CORSI, A. ILICETO, A. PREVI, and A. TASCHINI (Ente Nazionale per l'Energia Elettrica, Direzione Studi e Ricerche, Milan, Italy) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 115-119.

Design features and goals of the photovoltaic array power system for Alicudi Island hamlets are described. The array will have two 40 kWe sections, a 3 kAh battery system, an inverter to assure three-phase, ac current, a data acquisition system, and a 60 kVA diesel back-up system. The semi-arid conic volcanic island has terraces and a slope ideally suited to installation of the array. A computer simulation was developed to optimize the output and load profile matching using historical insolation data. A block diagram is provided of the electricity distribution network. M.S.K.

A83-32191

SOLAR GENERATOR PERFORMANCE WITH LOAD MATCHING TO WATER ELECTROLYSIS - LONGTERM AVERAGES AND RANGE OF INSTANTANEOUS EFFICIENCIES

K. FREUDENBERG (Muenchen, Universitaet, Munich, West Germany) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 135-138.

Performance results of a solar cell array coupled to a hydrogen producing electrolyzer are presented. The ultimate performance of the system is dependent on the cell efficiencies, the load matching, and the electrolyzer efficiency. An electronic simulation of an electrolyzer operation was connected to a solar cell array to determine the significant parameters over a six month operational period. Load matching losses, arising when the electrolysis does not draw power, were avoided by altering the system voltages. The array of 30 monocrystalline Si cells displayed a 10 pct efficiency with 800 W/sq m input at 293 K, average. The load matching was significantly influenced by the ambient temperature. Interposition of electrochemical cells in lesser amounts in low temperatures and greater amounts at high temperatures improved the overall system performance, which could be controlled to 8.9 pct losses over the lifetime of the experiment. The total system efficiency was calculated to be 8.0 pct. M.S.K.

A83-32192

PHOTOVOLTAIC POWER FOR WALK-IN COOLERS

L. SELLES and B. AUBERT (Societe Renault Ingenierie, Bois-d'Arcy, Yvelines, France) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 139-143.

The results of design studies to assess the effectiveness of remote installations of solar-cell powered refrigeration units for hot climates and harsh environments are reported. The studies examined the energy balances, the relative performances of dc and ac operations, design and dimensioning, operation of a 10 cu m prototype. A temperature between 0-7 C was selected and energy balances were determined for 10, 20, and 30 cu m refrigeration units. Analyses indicated that a 3 kVA inverter offered the highest system efficiencies, e.g., over 90 pct. Storage systems of lead-acid batteries and eutectic plates are being examined to ensure that no down time occurs with the units. The battery system for the prototype will have 37 elements, hold 200 Ah at 4 V, and be augmented by 8 eutectic plates. The total power consumption is projected as 1560 W for 2.3 kW of cold at -10 to 58.8 C.

M.S.K.

A83-32193

RESIDENTIAL APPLICATIONS OF PHOTOVOLTAICS IN THE UNITED STATES

S. J. STRONG (Solar Design Associates, Lincoln, MA) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 151-155.

A83-32194

PERFORMANCE TESTING AND MODULE MONITORING AT THE EC NECESSARY STEPS TO DEVELOP COST-EFFECTIVE PV MODULES

K. KREBS (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 158-168. refs

Testing programs carried out by the European Communities to establish testing techniques and standards for verifying the reliability and integrity of solar cells intended for the marketplace are described. The efforts are being expended to assure quality control and certification for photovoltaic (PV) products manufactured in any of the member nations. The failure rate for PV modules was lowered to 0.5 pct/year by 1981, and single cell failures are projected to be lowered to 0.00001/yr, connectors to 0.001/yr, and batteries to 0.01/yr. Day/night thermal cycling causes the most dominant type of failures, i.e., cracked cells and interconnect defects. Tests have been standardized for inspection, verification, performance, mechanical loading, hail impact, damp heat, high temperature long exposure, hot-spot heating, thermal cycling, and humidity-freezing tolerance. M.S.K.

A83-32195* Jet Propulsion Lab., California Inst of Tech., Pasadena.

RELIABILITY AND PERFORMANCE EXPERIENCE WITH FLAT-PLATE PHOTOVOLTAIC MODULES

R. G. ROSS, JR. (California Institute of Technology, Jet Propulsion Laboratory, Energy Technology Engineering Section, Pasadena, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 169-178. refs

Statistical models developed to define the most likely sources of photovoltaic (PV) array failures and the optimum method of allowing for the defects in order to achieve a 20 yr lifetime with acceptable performance degradation are summarized. Significant parameters were the cost of energy, annual power output, initial cost, replacement cost, rate of module replacement, the discount rate, and the plant lifetime. Acceptable degradation allocations were calculated to be 0.0001 cell failures/yr, 0.005 module failures/yr, 0.05 power loss/yr, a 0.01 rate of power loss/yr, and a 25 yr module wear-out length. Circuit redundancy techniques were determined to offset cell failures using fault tolerant designs such as series/parallel and bypass diode arrangements. Screening processes have been devised to eliminate cells that will crack in operation, and multiple electrical contacts at each cell compensate for the cells which escape the screening test and then crack when installed. The 20 yr array lifetime is expected to be achieved in the near-term. M.S.K.

A83-32196

OPERATIONAL EXPERIENCE WITH INTERMEDIATE FLAT-PLATE PHOTOVOLTAIC SYSTEMS

V. V. RISSER and H. S. ZWIBEL (New Mexico Solar Energy Institute, New Mexico State University, Las Cruces, NM) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 179-183.

Operating features, data acquisition, and fault isolation and maintenance procedures at 20 kWp and 100 kWp photovoltaic (PV) installations in Texas and New Mexico are discussed. Weather and system performance are sensed each minute, averages are calculated for each ten readings, and data is stored on magnetic tape. A total of 84 parameters, including 64 string currents, are recorded at the 20 kWp array and 84 parameters, with 42 string currents, are traced in New Mexico. The 20 kW array is coupled to a 197 MW utility power plant, which determines the voltage of the array. It produced 12 MWh in one yr of operation, functioning at 24 pct overall efficiency. The 100 kWp system is coupled to a 60 kW power conditioning unit and feeds a shopping center, producing 8 pct of the annual load with a cap factor of 25 pct and 192 MWh of dc current produced in one year. It was found

that under normal conditions washing the panels is not economically justified in terms of the small power lost if washing does not occur. It is concluded that the PV arrays can be successfully used in an automated operation mode. M.S.K.

A83-32197
OPERATIONAL EXPERIENCE WITH A 35-KWP
CONCENTRATING PHOTOVOLTAIC SYSTEM

R. M. SPENCER (Acurex Corp., Mountain View, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 184-188

Design, installation, and performance features of a 35 kWp concentrator photovoltaic (PV) array on Kauai, Hawaii are described. The actively-cooled arrays feed 80 C water to a storage vessel in a hospital and also supply 480 Vac to the island grid. A 12-step bridge has been incorporated into the power conditioning unit to eliminate all harmonics below the 19th. The island environment permits accelerated testing of the thermal cycling and salt spray environments and the reliability of the cooling system. Two ground faults have been experienced, together with module glass cracking, a factor which was determined to occur at a 0.5 pct annual rate. Heat conductive grease was needed in the encapsulant, and the high humidity environment produced 11 failures in the data acquisition system in 6 mos. Galvanized metal resists the salt air and a sacrificial Zn anode and anticorrosive additive protected the fluid loop. M.S.K.

A83-32198
SOLAR PHOTOVOLTAIC SYSTEMS IN THE DEVELOPMENT OF
PAPUA NEW GUINEA

G. H. KINNELL (Department of Minerals and Energy, Konedobu, Papua New Guinea) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 189-202. refs

Geographic and demographic features of Papua New Guinea are summarized, together with current applications of photovoltaic (PV) systems. The PV systems displace the increasing costs of generating power from diesel and kerosene powered units. PV systems power air navigation aids for the extensive air transport used in the absence of a road system. Remote television and visual aid education is possible with PV modules. A total of 50 kW of PV power is presently implemented, with the bulk dedicated to microwave repeater stations, navigation aids, and radio and lighting supplies. A village pumping installation is in operation, as are office lighting and ventilation, house lighting, and construction camp lighting. Another 350 kW is planned for the next 10 yr to run medical supply refrigeration, and further growth is seen for coupling with government-developed village lighting kits that feature industrial reflectors. M.S.K.

A83-32199
FIELD TRIAL OF RURAL SOLAR PHOTOVOLTAIC SYSTEM

P. BASU, K. MUKHOPADHYAY, T. BANERJEE, S. DAS, and H. SAHA (Kalyani, University, Kalyani, India) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 203-209. Research supported by the Ministry of Science and Technology of India. refs

Experience, costs, and performance of photovoltaic (PV) systems set up in a remote Indian village to power an adult literacy center and an irrigation pump are described. The center was furnished with a 14-module, 200 W array to power a television and three fluorescent lamps. The pumping installation has 20 modules for a 300 W output directly coupled to a 300-W dc pump motor. Data were gathered on the open circuit voltage, short circuit current, specific gravity of the battery fluid, degradation of the cells, nominal operating temperature of the cells, load currents, Amp-hours, water flow rate (pump), and the static head and draw down rate (pump). Monitoring of the array performances in the dusty environment showed that once/week cleaning is necessary. Al-substrates cracked at the center installation and sealant

evaporation caused condensation which degraded the light transmissivity and thereby the short-circuit current of the modules. The combination of low-efficiency (5 pct) cells and cheap labor demonstrated economic operation without high-efficiency cells. M.S.K.

A83-32200
STUDY OF A PHOTOVOLTAIC CONCENTRATING SYSTEM LIKE
'SOPHOCLE' IN FLUCTUATING MODE

B. LAURENT, V. V. PHAM, and G. VIALARET (CNRS, Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 212-216

Performance results and theoretical considerations derived from several years of operation of various Fresnel-lens Si-solar cell concentrator power systems as part of the French Sophocle program are presented. The installations were placed in various climates and monitored with data recording equipment to verify the systems' operating characteristics. Data included the ambient temperature, radiation temperature, total insolation, power delivered, rate of exceeding the 350 kW/sq m limit, and the calculated efficiencies. Correlations with performance predictions generated from the Monte Carlo method reached 99 pct. An Alger installation demonstrated that efficiency varies according to the ambient temperature, the wind speed, and the insolation. Time constants and optimized storage formulations were developed, and the thermal resistance of the units was averaged to be 0.017 deg C/W per sq m. M.S.K.

A83-32201
PERFORMANCE OF 1 KW PEAK CONCENTRATING
PHOTOVOLTAIC ARRAY

G. SALA and F. CHENLO (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 217-221

Performance data from 12 mos of operation of a 72 X concentrating Si solar cell array in Spain are summarized. Fresnel lenses were mounted above the encapsulated solar cells on a tracking array. The cells' efficiencies were determined to be 11.6 pct at 36 suns and 55 C. Series resistance of the cells increased under uneven illumination. Each module had four cells connected in parallel and although the short-circuit currents and fill factors of the cells were unequal, the open-circuit voltages were equivalent and so negligible connection losses were incurred. Hot spots were avoided in the array by the inclusion of shunt diodes. The implementation of uniform acrylic Fresnel lenses and conventional solar cells yielded a module efficiency of 10.2 pct at 40 C at an array cost of \$6/Wp. M.S.K.

A83-32202
PHOTOVOLTAIC CONCENTRATOR MODULE
CHARACTERIZATION

H. J. GERWIN (Sandia National Laboratory, Albuquerque, NM) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 222-226. Research supported by the U.S. Department of Energy.

Examples of concentrator module solar cell arrays tested at Sandia Laboratories in New Mexico are described. All the modules were produced from 1979-1981. Monitoring is carried out for performance in natural sunlight and in off-design conditions. Data is gathered in terms of current-voltage scans, power efficiencies, and operating points for different insolation levels. M.S.K.

A83-32203

RESULTS FROM A TEST FACILITY FOR SOLAR CELLS IN SWEDEN

J HEDSTROM, B KALLBACK, and D. SIGURD (Institute of Microwave Technology, Stockholm, Sweden) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D Reidel Publishing Co., 1982, p. 227-231 Research supported by the National Swedish Board for Energy Source Development.

Climatological and design characteristics of the Swedish solar cell test station are presented, together with theoretical models for determining cell operating parameters. On-line data is collected on insolation, voltages, and panel temperatures, with the capability thus far applied to simultaneous testing of six cell modules. The system is equipped for 1 kW of input. The modules are removed once a year for cleaning and inspection to reveal defective cells and measure performance in a solar simulator. Power losses to date have been 4-5 pct due to dust and 3-4 pct due to snow cover, which occurs in winter when little insolation is available. Optimization of the voltage load has resulted in annual cell outputs within 96 pct of that projected for a peak power tracking mode.

M S K.

A83-32204

A MICROPROCESSOR-BASED INSTRUMENT FOR AUTOMATIC SOLAR CELL CHARACTERIZATION

G C CARDINALI (CNR, Istituto LAMEL, Bologna, Italy) and E FALDELLA (Bologna, Università, Bologna, Italy) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D Reidel Publishing Co., 1982, p. 232-236

A system which digitally records solar cell performance parameters is discussed and the design of a microcomputer based measurement system for solar cells is described. The key parameter is the current-voltage characteristic, assayed by sweeping the bias voltage to vary the cell output voltage from zero to the open circuit value at a load resistance which is varied to values of the ratio of the open circuit voltage and the short circuit current. Analog/digital and digital/analog conversion permits the interface of the microprocessor with an electronic load circuit. A system configured for the measurement includes a CPU running at 6.144 MHz, a programmable communication interface, a programmable interval timer, and the logic for buffering and driving the system bus. The operator is required to define the measurement modalities, the output data selection, and the cell selection criteria. Expansions into remote storage on a mainframe computer and continuous control of the light source are under investigation.

M S K.

A83-32205

SUBSYSTEM ENGINEERING AND DEVELOPMENT OF GRID-CONNECTED PHOTOVOLTAIC SYSTEMS

E L BURGESS, H N POST, and T S KEY (Sandia National Laboratory, Albuquerque, NM) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 238-247 Research supported by the U S Department of Energy refs

M.S.K.

The results of testing full scale subsystems for photovoltaic modules which generate power for grid interconnection are summarized. The trials were performed at Sandia Labs and covered the structures, foundations, field wiring, electrical subsystem protection, site preparation, and the power conditioning equipment. The goal was to characterize potential cost-reduction measures that would aid in making the solar cell systems competitive with grid-supplied power from conventional energy sources. Most data is from flat plate arrays, which were found to have similar designs, indicating that standardized production is possible. Recommendations are provided for mounting the cells in retrofits and new installations, and innovative wiring is suggested as a means to eliminating costly junction boxes. Totally integrated, modular field arrays which have incorporated the design

recommendations are described. Production of systems with 10 pct efficiency at a subsystem cost of \$0.77/Wp is predicted.

A83-32206

ARRAY STRUCTURES FOR FIXED FLAT-PLATE PHOTOVOLTAIC POWER GENERATORS

G GRASSI (Commission of the European Communities, Brussels, Belgium) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D Reidel Publishing Co., 1982, p. 248-257

Several structural concepts intended to reduce photovoltaic module support structure costs are presented. The structures can be made of galvanized steel, aluminum, reinforced concrete, and wood, with consideration given to a concrete slab base and screwing or welding the structure together. Wood treated with preservative resists weathering, insects, and fungi. Details of the site selection and preparation processes are provided, noting that the use of wood offers the potential of reducing the cost of the support systems to \$0.1-0.2/Wp. Galvanized steel wire guy cables and module beds are included in the design. The wooden structures, if made of treated chestnut or Azobe wood, are projected to have 25 and 40 yr lifetimes, respectively.

M.S K

A83-32207

A SUPPORT STRUCTURE FOR INTERMEDIATE PV SOLAR PLANT

V ALBERGAMO (ENEA - National Committee for Research and Development of Nuclear and Alternative Energies, Rome, Italy), P L BORLENGHI (Studio Moretti, Rome, Italy), F. CHELI, G DIANA (Milano, Politecnico, Milan, Italy), and M FALCO (Catania, Università, Catania, Italy) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D Reidel Publishing Co., 1982, p. 270-274 In Italian refs

A new type of support structure for an intermediate photovoltaic plant is proposed. The structure consists of parallel wire-ropes anchored to the ground and supported by A-type poles, photovoltaic panels are suspended between parallel ropes. This structure offers the advantages of modularity, extremely high PV field packing factor, light weight, ease of trucking and mounting in remote areas, ease of maintenance and cable routing, and very low ground leveling and foundation work. One disadvantage is that flutter and buffeting may occur due to wind effects on the panels. First results are presented.

B J

A83-32208

LOW COST MODULAR DESIGNS FOR PHOTOVOLTAIC ARRAY FIELDS

H. N POST (Sandia National Laboratory, Albuquerque, NM), D C. CARMICHAEL (Battelle Columbus Laboratories, Columbus, OH), and J A. CASTLE (Hughes Aircraft Co., Los Angeles, CA) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 275-279 Research supported by the U.S. Department of Energy.

Two balance-of-system (BOS) designs for photovoltaic module array support structures were designed for minimized cost. The baseline design comprised a field operating voltage of 400 Vdc, compliance with codes and safety requirements, a 10 pct module efficiency, and near-term use. The designs for similar, 2 x 4 ft modules, include either treated wood beams or concrete curbs, lightweight steel angle structures, either crimp-spliced pigtail or folded daisy chain with quick-disconnect connectors, and direct-burial cabling. Modular building blocks of one or two rows of mounted modules make up the arrays. The wood and concrete footing designs are projected to cost \$51.93 and \$62.92/sq m, respectively, if installed in 1982/1983 in low-production quantities. Project engineering costs are lowered by the use of standardized designs and components.

M.S K.

A83-32209**THE PHOTOVOLTAIC SOLAR SYSTEM - ANALYSIS AND BASIC DESIGN RULES**

A. H. M. KIPPERMAN (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 280-285. Research supported by Holec.

Photovoltaic array designs developed for two European sites are presented, with consideration given to cost optimization of the systems with respect to the array output and the storage requirements. The control system programming is conditioned by the statistically determined insolation at a site and the necessity of supplying uninterrupted power to the load. The sizing of the battery storage system depends on costs considered for other back-up power generation and the value of the product of the power usage, with the additional consideration of the natural diurnal cycle of power generation. The two systems considered produce 1 kWh/day, with 20 pct needed in the daytime, a battery system with a 60 pct depth of discharge, 70 pct efficiency, and a four year life at \$200/kWh. It is shown that no clear-cut optimum design is possible for one system, although an array design can be chosen with the minimum possible cost to achieve the required output.

M.S.K.

A83-32210**A DETAILED PACKAGE OF DIGITAL CODES SPECIALLY DEVELOPED FOR THE ARRAY DESIGN**

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Computer codes are presented which can be used in sensitivity analyses of photovoltaic (PV) array construction parameters when low-cost structures serve as the bases. The SOL-3 computer program package contains three different codes. SEPRa models the global solar radiation on a horizontal plane, including the direct and diffuse components. DIST simulates the solar radiation distribution during daylight hours and generates curves to simulate the solar radiation trend, including cloudy days. INCLI computes the direct and diffuse solar radiation, transferred from a horizontal to an inclined plane and its output is the radiation density on a selected plane. The input for INCLI can be the output of SEPRa and DIST. The programs permit calculation of the difference between an optimized performance at a site and the performance that can be expected with a different mounting. The total available radiation can also be computed. The total electricity produced is then calculated, and a breakdown of the costs of the entire array and its components is available. It is shown that cutting the support structures costs can have more significant economic benefits than optimizing the orientation of the PV cells.

M.S.K.

A83-32211**ANALYSIS OF HOT-SPOT-EFFECTS IN ENCAPSULATED PHOTOVOLTAIC GENERATORS BY LASER SCAN AND PARTIAL SHADOWING**

G. H. HEWIG and H.-P. HUEBNER (Stuttgart, Universitaet, Stuttgart, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 291-295. Research supported by the Bundesministerium fuer Forschung und Technologie.

Theoretical and experimental analysis were carried out on the sensitivity of encapsulated solar cell power generators to the appearance of hot spots. It is noted that mass produced solar cells, even if inspected before installation in a sealed module, will display small variations in the IV characteristics of individual cells. The IV curve for the entire generator is expressed as the sum of the IV curves of individual cells, and the power is consumed by the load and the cell with the lowest open circuit voltage. The shunt resistance and the reverse dark characteristic is calculated

for each cell to identify the cell which will act as a load. A laser scan reveals the short circuit current by illuminating a small area of the cell surface and the rest of the cell acts as a load, revealing the shunt resistance. A series of 36 cells were examined by means of the method and the ability to detect the cells that heat due to higher shunt resistance was demonstrated.

M.S.K.

A83-32212**REVERSE BIAS POWER DISSIPATION OF SHADOWED OR FAULTY CELLS IN DIFFERENT ARRAY CONFIGURATIONS**

P. SPIRITO (Napoli, Universita, Naples, Italy) and V. ALBERGAMO (ENEA - National Committee for Research and Development of Nuclear and Alternative Energies, Rome, Italy) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 296-300. refs

The influence of different photovoltaic (PV) array configurations on the reverse bias power dissipation of a faulty cell is considered. Account is taken of the thermal characteristics of different modules and varying cell behaviors in the presence of reverse bias. The maximum cell temperature is dependent on the thermal conductivity of the module. The power dissipation of a cell is related to the shape of the reverse bias IV curve of the cell, the extent of mismatch between a faulty cell and other cells, and the array configuration. Mismatches are formulated in terms of the shadowing degree, i.e., the ratio between the reduced short circuit current and the short circuit current of a good cell. Series-parallel and parallel-series connections are discussed, and it is found that fault propagation can occur in a parallel-series connection due to enhanced power dissipation being induced in the good cells of the faulty parallel. The effect is multiplied by shadowing of more than one cell.

M.S.K.

A83-32213**DISEQUILIBRIUMS IN SERIES CONNECTED SOLAR CELLS - AN APPROACH TO THE PROTECTION BY PARALLEL DIODES**

J. A. ROGER, S. MASSAAD, J. POSBIC, and J. PIVOT (Lyon I, Universite, Villeurbanne, Rhone, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 301-306.

The present investigation is concerned with experiments and theoretical studies which have been conducted to obtain a better understanding of problems occurring in connection with the operation of high-power arrays consisting of solar cells which are connected in series. Differences in cell characteristics and an accidental shading of a part of the surface of the modules can lead to a voltage inversion in the case of one or more cells. The lack of uniformity in operating conditions for the individual cells can produce temperatures which may exceed the maximum temperature that can be tolerated by the encapsulation. Protection can be provided with the aid of by-pass diodes. The possibility to provide each cell with a by-pass electrode has, therefore, been investigated, taking into account the feasibility to incorporate a diode directly into the silicon wafer for each cell.

G.R.

A83-32214**MINIMUM COST OF PHOTOVOLTAIC ENERGY FOR A UTILITY GRID AND GENERAL FEATURES OF A GENERATING PLANT USING COSTLESS SOLAR CELLS.**

D. MADET (Electricitede France, Direction des Etudes et Recherches, Chatou, Yvelines, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 307-311.

The present investigation has the objective to evaluate the minimum long-term cost of electricity produced by photovoltaic plants connected to a utility grid. In connection with expectations that the cost of photovoltaic cells will decrease dramatically, the assumption is made that, in the long run, this cost will be close to zero. A computer program was developed for optimizing the various electrical, physical, and economic characteristics of the plant. The minimum cost of photovoltaic energy was calculated,

taking into account weather conditions typical for the south of France. Attention is given to the main features of a solar plant, details regarding the computer program, and the application of the optimization program to a number of specific cases. G.R.

A83-32215

A DC/AC MODULAR INTERFACE FOR PHOTOVOLTAIC SYSTEMS

M. VAN GYSEL (IDE, Rochefort, Belgium) and N. LIMBOURG (Etudes Techniques et Constructions Aérospatiales, SA, Brussels, Belgium). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 312-315. Research supported by the Ministère de la Région Wallonne and Commission of the European Communities.

A83-32216

SIMPLE TRANSFORMERLESS INVERTER WITH AUTOMATIC GRID-TRACKING AND NEGLIGIBLE HARMONIC CONTENT FOR UTILITY INTERACTIVE PHOTOVOLTAIC SYSTEMS

J. SCHMID and R. SCHAETZLE (Fraunhofer-Institut fuer Solare Energiesysteme, Freiburg im Breisgau, West Germany). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 316-319.

A83-32217

REGULATED CONVERTER CIRCUIT FOR DIRECT PHOTOVOLTAIC ENERGY FEEDBACK INTO THE POWER GRID

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A new regulated utility interactive (UI) inverter for direct photovoltaic energy feedback to the mains has been realized. The inverter acts as a current source, its output is a sinewave with negligible harmonic distortion and has a projected efficiency of over 90 percent. A novel maximum power tracking (MPT) strategy based on a simple current peak error detection is described.

Author

A83-32218

POWER CONDITIONING IN SOLAR PHOTOVOLTAIC ARRAY APPLICATIONS

G. J. VACHTSEVANOS, C. K. KALAITZAKIS, and E. J. GRIMBAS (Thrace, University, Xanthi, Greece). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 325-329.

The present study is concerned with the design and the implementation of equipment for power conditioning applications in systems in which photovoltaic arrays are connected with the utility grid. Attention is given to problems of maximum power transfer from the photovoltaic array to the utility grid, the reliability of system operation, and aspects of component protection. A system description is provided, taking into account the nonlinear voltage-current relation, a synchronous inverter with a four-thyristor bridge, the feedback circuit with a A/D converter and 'memory and logic' circuit, and the power grid. G.R.

A83-32219

MISMATCH BETWEEN BATTERIES AND TWO MODULE TYPES P.V. ARRAYS INTEREST OF D.C.-D.C. CONVERTERS

P. GUCHER, J. A. ROGER, S. MASSAAD, J. POSBIC, and J. PIVOT (Lyon, Institut de Chimie et Physique Industrielles, Lyons; Lyon I, Université, Villeurbanne, Rhône, France). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 330-334. Sponsorship: Délégation Générale à la Recherche Scientifique et Technique and Commissariat à l'Énergie Solaire.

(Contract DGRST-77-2011, COMES-78-03192; COMES-78-03292)

The present investigation is concerned with the effects produced by a lack of matching between the photovoltaic arrays and the batteries to which the arrays are connected. Questions of coupling between photovoltaic arrays and batteries are investigated, taking into account experiments involving two kinds of modules with different encapsulation structures. These structures include a type A involving a glass-glass encapsulation and a type B which uses an organic material rear face. Problems arising in connection with the introduction of a dc-to-ac converter are discussed. In the case of the batteries, difficulties are related to the smoothing of the current delivered to the load. A capacitance is employed for the intermediate storage of the energy to be transferred. G.R.

A83-32220

MATCHING THE CHARACTERISTICS OF BATTERIES WITH SOLAR CELL MODULES

C. F. GAY, V. K. KAPUR, B. PYLE, J. RUMBURG (ARCO Solar, Inc., Chatsworth, CA), and A. MANFREDI (ARCO Solar Europe S.p.A., Milan, Italy). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 335-339.

The typical photovoltaic (PV) power system consists currently of one or a few PV modules. Each module contains from 32 to 40 cells. The modules are connected to one or more six-cell (12 V) lead-acid batteries through a voltage regulator or charge controller. Input conditions for design optimization are discussed, taking into account the basic system, the standard solar day and typical variations, and the dependence of PV module performance on insolation and temperature. Problems regarding the matching of the module voltage to battery characteristics are considered, and a description is provided of the results obtained with a module which was designed to satisfy certain requirements. The investigation shows that it is possible to design a photovoltaic generator to match appropriate characteristics of the battery, taking into account the possibility to maintain self-regulation in practical field operations. G.R.

A83-32221

CALCULATION TO IMPROVE POWER CONVERSION EFFICIENCY IN PHOTOVOLTAIC SYSTEMS

A. MAS, J. GARCIA, L. CLOSAS, M. INSAUSTI, and L. CASTANER (Escuela Técnica Superior de Ingenieros de Telecomunicación, Barcelona, Spain). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 340-344.

A83-32222

FLAT PLATE MODULE TECHNOLOGY - OVERVIEW

F. FABRE (Photowatt International, S.A., Rueil-Malmaison, Hauts-de-Seine, France). IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 346-352.

The various processing steps which are currently used to produce a photovoltaic module are examined. It is found that the 'semiconductor grade' silicon employed by the photovoltaic industry as feedstock is not really ideally suited for solar cells. The specifications for the semiconductor grade are not optimized for a use in solar cells, and the cost is much too high. A number of

approaches are currently being investigated to obtain material for solar cells at a much lower cost than that involved in a use of single crystal wafers. Attention is given to the preparation of a 'solar-grade' material. Feedstock material is to be obtained at a cost of less than \$20 per kg. Developments related to the cell process are also discussed, along with problems of module assembly. G.R.

A83-32223

AM/PM - THE RATING SYSTEM FOR PHOTOVOLTAIC MODULES

C. F. GAY (ARCO Solar, Inc., Chatsworth, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 353-361.

The currently employed systems for rating photovoltaic modules are critically examined. It is found that the peak-watt rating and its improvement, the NOCT rating, are virtually useless for the actual user of the modules. There is a need for a rating system which will provide a reliable prediction of the energy per unit product for an average day or year, taking into consideration the energy which will be delivered from an average site. The average day's output rating must take into account the solar array's response to varying conditions. The adoption of a rating standard which will meet these requirements is proposed. The proposed standard is called the 'AM/PM standard', because it is based on the whole day rather than just the 'peak' sunshine hours, or solar noon, or a millisecond in a laboratory simulator. G.R.

A83-32224* Jet Propulsion Lab., California Inst of Tech., Pasadena.

RECENT PROGRESS IN TERRESTRIAL PHOTOVOLTAIC COLLECTOR TECHNOLOGY

R. R. FERBER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 364-368. Research sponsored by the U.S. Department of Energy and NASA.

The U.S. Photovoltaic Research and Development Program has the objective to develop the technology necessary to foster widespread grid-competitive electric power generation by the late 1980s. The flat-plate and the concentrator collector activities form the nucleus of the program. The project is concerned with the refining of silicon, silicon sheet production, solar cell processing and fabrication, encapsulation materials development, and collector design and production. The Large-Area Silicon Sheet Task has the objective to develop and demonstrate the feasibility of several methods for producing large area silicon sheet material suitable for fabricating low-cost, high-efficiency solar cells. It is expected that a variety of economic flat-plate and concentrator collectors will become commercially available for grid-connected applications. G.R.

A83-32225* Jet Propulsion Lab., California Inst of Tech., Pasadena.

LOW-COST SOLAR ARRAY PROGRESS AND PLANS

W. T. CALLAGHAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 369-373. Research sponsored by the U.S. Department of Energy.

It is pointed out that significant redirection has occurred in the U.S. Department of Energy (DOE) Photovoltaics Program, and thus in the Flat-Plate Solar Array Project (FSA), since the 3rd European Communities Conference. The Silicon Materials Task has now the objective to sponsor theoretical and experimental research on silicon material refinement technology suitable for photovoltaic flat-plate solar arrays. With respect to the hydrochlorination reaction, a process proof of concept was completed through definition of reaction kinetics, catalyst, and reaction characteristics. In connection with the dichlorosilane chemical vapor desposition

process, a preliminary design was completed of an experimental process system development unit with a capacity of 100 to 200 MT/yr of Si. Attention is also given to the silicon-sheet formation research area, environmental isolation research, the cell and module formation task, the engineering sciences area, and the module performance and failure analysis area. G.R.

A83-32228

MODULE DESIGN FOR EC PILOT PROJECTS

J. DONON, J. ANGUET, A. DESOMBRE (Photowatt International, S. A., Caen, France), and P. COUREAU (Photowatt International, S. A., Rueil-Malmaison, Hauts-de-Seine, France, IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 387-391.

The solar cell module designed for use at the Nice Airport and Mont Bouquet, France pilot projects has a 73 W output and is made up of 72 100-mm diameter single-crystal silicon cells. A cost reduction is obtained through the use of a laminated encapsulation structure which incorporates low iron content glass, polyvinyl butyral, and a Tedlar/aluminum sheet backing. These technologies have been selected to yield high reliability in severe environmental conditions and to permit fast on-site installation. It is hoped that this solar cell module can be used in tropical climates. O.C.

A83-32235

VALIDITY OF THE EFFECTIVE LIFETIME CONCEPT IN POLYCRYSTALLINE SILICON

S. C. JAIN (Solid-State Physics Laboratory, Delhi, India), R. JANSSENS, G. CHEEK, P. DEPAUW, R. MERTENS, and R. VAN OVERSTRAETEN (Leuven, Katholieke Universiteit, Heverlee, Belgium) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 432-436. Research supported by the Nationale Fonds voor Wetenschappelijk Onderzoek. refs

In the present examination of the 'effective lifetime' concept of minority carriers that is frequently employed in solar cell calculations, for the case of polycrystalline silicon, it is noted that the effective grain boundary surface recombination velocity is not linear in the minority carrier concentration. While the problem can be linearized for the case of a recombination velocity sufficiently large to limit the diffusion current to the grain boundary, by means of the diffusion velocity, a large recombination velocity poses convergence problems. O.C.

A83-32241

SPECTRUM SHIFTING METHODS IN PHOTOVOLTAICS - AN EVALUATION OF MODEL SYSTEMS

F. GALLUZZI and E. SCAFE (ASSORENI, Laboratori di Ricerche, Rome, Italy) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 477-481.

A single, unified approach is used for the analysis of photovoltaic systems employing spectral distributions different from that of the sun. The spectral transfer function introduced allows effective spectral responses and photocurrents to be calculated for several representative situations. Attention is given to the analysis of thermophotovoltaic converters, planar luminescent concentrators, and flat modules with fluorescent covers. O.C.

A83-32246

SERIES RESISTANCE ANALYSIS OF CONCENTRATOR CELLS UNDER HIGH INJECTION CONDITIONS

J. M. RUIZ, M. CID, A. CUEVAS, and A. LUQUE (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 511-515. refs

The performance of silicon solar cells having either low or high base resistivity under concentration is presently analyzed by

means of low and high injection level analytical models whose ranges of applicability are determined through comparison with the exact model. The theoretical results obtained indicate that a high base region resistivity does not degrade cell performance even at high concentration levels, and that low resistivity and high resistivity cells have similar efficiencies. The experimental results presented agree qualitatively with these theoretical predictions O.C.

A83-32247
THE INFLUENCE OF GRAIN-BOUNDARY RECOMBINATION AND GRAIN SIZE ON THE I(V)-CHARACTERISTICS OF POLYCRYSTALLINE SILICON SOLAR CELLS

M BOEHM, R KERN, and H G. WAGEMANN (Berlin, Technische Universitaet, Berlin, West Germany) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 516-521. Research supported by the Deutsche Forschungsgemeinschaft. refs

A83-32250
DESIGN OF STABLE METAL-INSULATOR-SEMICONDUCTOR (MIS) SOLAR CELLS BY OXIDE THICKNESS COMPENSATION

G RAJESWARAN and W A ANDERSON (New York, State University, Amherst, NY) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 532-536 refs

An assessment is made of the prospects for low cost, moderate efficiency photovoltaic conversion of sunlight by means of metal insulator semiconductor (MIS) solar cell structures, in view of performance degradation due to their metal/oxide interface, which results in an oxide thickness reduction with time. In the present case of a Cr/SiO(x)/Si device, the oxide thickness must be overcompensated in order to counter the process of degradation, and a higher degree of stability is obtained. Attention is also given to an example of a novel interface approach for the solution of stability problems, consisting of a class of Yb-MIS devices employing indirect oxide thickness reduction compensation, which possess exceptional stability. O C

A83-32251
STUDY OF GAP STATES IN A-Si:H BY TRANSIENT CURRENT SPECTROSCOPY

J BEICHLER and H MELL (Marburg, Universitaet, Marburg, West Germany) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 537-541 Research supported by the Bundesministerium fuer Forschung und Technologie refs

Schottky barrier structures have been made with n-type hydrogenated amorphous silicon (a-Si:H) prepared by the glow discharge decomposition of SiH₄. The density of gap states N(E) in the depletion layer of these diodes has been determined by analyzing the current transients caused by the emission of electrons after removal of a small forward bias. Depending on the preparation conditions, the dopant concentration and the history of the structures (exposure to light, electron bombardment) N(E) near midgap ranges from 3 x 10¹⁵ to the 15th to 10 to the 18th per cu cm. The distribution of states is more similar to that deduced from field effect and space charge limited current data than to DLTS results Author

A83-32252
HIGHLY CONDUCTIVE BORON DOPED SI-LAYERS PREPARED BY PLASMA DECOMPOSITION OF SiH₄

H SIMON, G WINTERLING, and G MUELLER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) IN Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 542-545. refs

Highly conductive SiB films were prepared by plasma decomposition of B₂H₆ SiH₄ mixtures strongly diluted with H₂. The main properties of these films are (1) dark conductivities up to 30/(ohm cm); (2) conductivity activation energies as low as 0.01 eV, an optical gap increased by at least 0.2 eV in comparison to a-Si:H, B although the H-contents are almost the same

Author

A83-32253
A MODEL FOR ANALYSIS OF OPTICAL MEASUREMENTS CARRIED ON A-Si:H FILMS FOR PHOTOVOLTAIC APPLICATIONS

L GUIMARAES, R MARTINS, A. G. DIAS, and F BARRADAS (Lisboa, Universidade, Lisbon, Portugal) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 546-550 Sponsorship Junta Nacional de Investigacao Cientifica e Technologica. refs (Contract JNICT-321,81/71)

A simple theoretical electromagnetic model relating optical properties, including absorption, multiple reflection, and interference, to deposition parameters for doped and undoped a-Si:H films prepared by RF glow discharge is presented and applied to experimental absorption measurements. The a-Si:H films were produced with both inductive and capacitive coupling by RF glow discharge in 3 percent SiH₄/Ar and deposited on a glass substrate. Undoped and doped (phosphine and diborane) films were made under identical conditions, except that the undoped films were deposited using crossed static electromagnetic fields. The theoretical model and its simplification are explained, the model successfully predicts optical properties in the low-absorption region. It is noted that these films are sensitized by doping and that their properties are dependent on deposition biasing. It is inferred that capacitive films made under negative bias (-50 to -100 V) should be best for photovoltaic applications A T

A83-32254
THE ASSESSMENT OF THIN FILM Cu(X)S-CDS SOLAR CELLS USING CATHODOLUMINESCENCE TECHNIQUES

T J. CUMBERBATCH, I D. MCINALLY (Thorn Emi, Ltd, Hayes, Middx., England), W K KE (University of Manchester Institute of Science and Technology, Manchester, England, Chinese Academy of Sciences, Semiconductors Institute, Beijing, People's Republic of China), and B. HAMILTON (University of Manchester Institute of Science and Technology, Manchester, England) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 551-556 Research supported by the European Economic Community, Department of Industry of England, and Science and Engineering Research Council refs

The object of this work has been to develop a rapid contactless technique for the routine assessment of thin film (less than 5-micron) polycrystalline Cu(x)S-CdS solar cells prepared by electrophoretic deposition. Cathodoluminescence (CL) is an ideal tool for this task since the data acquired from its three modes of operation (imaging, spectral analysis, decay analysis) can be correlated to provide detailed information about the chemical composition and electrical activity of the constituent materials

Author

A83-32255

PHOTOVOLTAIC EFFECT IN SNTe/CDTE JUNCTIONS

M. KANE, G. W. COHEN-SOLAL, D. LAPLAZE (Dakar, Université, Dakar, Senegal), and G. COHEN-SOLAL (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts-de-Seine, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 557-561 refs

Studies of pSnTe/nCdTe junctions show that band diagrams of these structures are closed to the Schottky diode model, with interfacial dead layer. In some cases, structures exhibit surface states. Using such model, theoretical calculations agree well with experimental spectral responses in the range 0.3-2-microns. Optimization of preparation parameters is expected to produce higher quantum efficiencies. Author

A83-32256

ORGANIC PHOTOVOLTAIC MATERIALS - POLYACETYLENE

J. KANICKI, S. BOUE, E. VANDER DONCKT (Bruxelles, Université Libre, Brussels, Belgium), and P. FEDORKO (Bruxelles, Université Libre, Brussels, Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 512-567 refs

The photovoltaic properties of the contacts between doped and undoped trans-polyacetylene films and In, Al, Pb, Sn, and Ni were studied. Measurements were performed at -77 C to +110 C at 0.00001 torr on films varying from 0.1 to 1 sq cm in area and from 20 to 75 microns in thickness. Current-voltage, capacitance-voltage, and photocurrent-voltage characteristics were determined. In the dark, the films were found to exhibit typical Schottky-barrier rectification behavior which was affected by differences in the polymer surface. Short-circuit-photocurrent-action spectra of the blocking contacts are shown to be identical with the 450-1000nm absorption spectra of polyacetylene, limiting collection efficiency to about 1 percent at 1.93 eV. Short-circuit current and open-circuit voltage are determined to be dependent on incident light intensity. Photovoltaic conversion efficiency is calculated to be approximately 0.1 percent. T.K.

A83-32258

STUDIES ON CDS/N-INP PEC SOLAR CELLS

Y. RAMPRAKASH, S. BASU, and D. N. BOSE (Indian Institute of Technology, Kharagpur, India) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 574-578. Research supported by the Council of Scientific and Industrial Research of India. refs

The photovoltaic performance characteristics of a photoelectrochemical cell composed of a 25-micron-thick CdS layer deposited by spray pyrolysis on an n-InP single-crystal electrode are presented and analyzed. The combination was chosen as a theoretically effective way of protecting the InP anode from photoanodic dissolution in the alkaline electrolyte (5M KOH with 0.1M sulfide/polysulfide redox system, pH = 10). The preparation of the cells and the experimental setup are described. Values determined included flat-band voltage (0.48 V), spectral response (0.5-0.8 microns), open-circuit voltage (0.35 V) and short-circuit current (1.37 mA/sq cm) under 75-mW/sq cm illumination, and cell efficiency (0.1 percent). The spectral response is shown to be characteristic of InP, with CdS acting mainly as a window. Cell stability was maintained for 72 hours. It is suggested that the poor efficiency of the cell, attributed to carrier recombination at the junction, can be improved by altering fabrication techniques or by doping the CdS film. T.K.

A83-32259

ADVANCED PHOTOVOLTAIC DEVICES

D. L. FEUCHT (Solar Energy Research Institute, Golden, CO) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 580-590. refs

The current status of research and development on photovoltaic materials and concentrator systems is surveyed. Polycrystalline-silicon-cell development is seen as focused on cheaper methods for producing high-quality Si sheets, such as edge-supported pulling and the low-angle silicon-sheet technique, on MIS/SIS devices, and on basic research into grain-boundary electrical properties. Other thin-film materials under study, including amorphous Si, CdS/CuInSe₂, GaAs, InP, CdTe, and Zn₃P₂, are characterized as promising but not yet developed alternatives to polycrystalline silicon. The potential value and present limitations of several types of multijunction and luminescent-plate photovoltaic concentrators are discussed. The chief advantage of the photoelectrochemical cells under development is considered to be their in situ energy-storage capacity, photoelectrode materials and protective coatings are discussed. Finally, a table of performance figures for 28 experimental cells is presented. While theoretical efficiencies up to 30 percent have been calculated for some designs, 10-15 percent efficiency is typical at present. T.K.

A83-32260

HIGH EFFICIENCY GAAS SOLAR CELLS FOR CONCENTRATOR AND FLAT PLATE ARRAYS

G. GUARINI (Centro Informazioni Studi ed Esperienze S.p.A., Milan, Italy) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 591-599. Research supported by the Ente Nazionale per l'Energia Elettrica and European Community. refs

Technological and economic-feasibility studies of thin-film GaAs photovoltaic cells and of concentration devices are presented. Thin films and high concentration are seen as the only way to reduce the cost of potentially very efficient GaAs solar converters. The most promising cell type is considered to be a 3-micron GaAs single-crystal layer over a 1-micron Ge layer, both applied to a low-cost Si substrate by organometallic chemical vapor deposition (MO-CVD), which would cost about \$0.56/Wp and have a modular efficiency of 18.8 percent. Recent applications of a spectrum-splitting, dichroic-filter approach and of a monolithic cascade approach to the design of multicolor solar-concentrator devices are surveyed; concentrators will require cells of at least 30 percent efficiency to be cost-effective. Experimental concentrators employing different types of GaAs and AlGaAs cells and a three-terminal stacked cell are presented. Modifications of three optical systems to increase efficiency (15 percent) are proposed. T.K.

A83-32261

PHOTOVOLTAIC CONCENTRATOR TECHNOLOGY IN THE USA

E. C. BOES and M. W. EDENBURN (Sandia National Laboratory, Albuquerque, NM) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 600-605. Research supported by the U.S. Department of Energy. refs

Research on the design of solar concentrators since about 1979 is surveyed. Concentrator modules employing point-focus-Fresnel, linear-Fresnel, parabolic-trough, and advanced point-focus-Fresnel optical elements are characterized; the Fresnel types are found to be more effective than the parabolic troughs. Tracking-structure types and array experiments are listed. Cell-efficiency improvements (such as planar-junction silicon cells, GaAlAs cells, and spectrum-splitting combinations) are seen as critical for enhancing module performance. Materials for use in heat exchangers and optics are discussed. Present microprocessor control of array pointing using closed-loop/sun-sensor or

open-loop/ephemeris tracking is considered adequate. Information on durability testing, a table of estimated array costs, and a table of design characteristics and efficiencies for operational and experimental concentrators are presented. Concentrators delivering up to 20-percent efficiency over a 20-year lifetime at an installed cost of \$1-\$2/peak W are considered feasible. T.K.

A83-32262

RECENT PROGRESS IN A RESIDENTIAL SOLAR ENERGY SYSTEM DEVELOPMENT

E. L. JOHNSON and J. S. KILBY (Texas Instruments, Inc., Dallas, TX) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 611-615 (Contract DE-AC01-79ER-10000)

A83-32263

HIGH EFFICIENCY TANDEM TYPE SOLAR CELLS CONSISTING OF A-Si:H AND A-SiGe:H

G. NAKAMURA, K. SATO, H. KONDO, Y. YUKIMOTO, and K. SHIRAHATA (Mitsubishi Electric Corp., LSI Research and Development Laboratory, Itami, Hyogo, Japan) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 616-620. Research supported by the Agency of Industrial Science and Technology.

The design and preparation of stacked-tandem amorphous solar cells with a-Si:H and a-SiGe:H elements is reported. The conditions for growing a-Si(1-x)Ge(x):H by glow discharge with capacitive-coupled plate electrodes were studied, and decreasing residual gas content in the discharge atmosphere is shown to increase the photoconductivity/dark-conductivity ratio and shift the Fermi level closer to the mid-band gap. The preexponential factor σ_0 is found to vary with conductivity activation energy, as predicted by the Meyer-Neldel rule. The design parameters of the tandem cell configuration are discussed, a two-cell and three-cell version were built and evaluated. The best results were obtained with a 3-stacked cell, consisting of 600-A and 4000-A-thick inverted p-i-n a-Si:H cells and a 5000-A-thick inverted p-i-n a-Si(0.6)Ge(0.4):H cell, and having an area of 9 sq mm: open-circuit voltage of 2.2 V, short-circuit current of 6.74 mA/sq cm, fill factor of 0.57, and conversion efficiency of 8.5 percent were achieved under AM1 illumination of 100 mW/sq cm. T.K.

A83-32264

HIGH EFFICIENCY SHALLOW P(+)NN(+) CADMIUM TELLURIDE SOLAR CELLS

G. COHEN-SOLAL, D. LINCOT, and M. BARBE (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts-de-Seine, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 621-626. In French. refs

The manufacturing processes, electrical and spectral response characteristics, and the performance of pnn junction CdTe solar cells are described. A 0.2-0.8 epitaxial layer was deposited on CdTe-p type cells doped with Ar on P using a close spaced CVD technique in a hydrogen atmosphere. The CdTe n-type substrates were doped with In, and the entire structure was thermally treated after annealing to restore the crystalline lattice. A back contact was formed by melting and diffusing indium in the hydrogen atmosphere. The cells exhibited a space charge zone of null polarization with a length of 0.1-0.3 microns. The saturation current was measured at 1.5×10^{-10} to 10^{-11} A/sq cm. The internal quantum efficiency was 95 pct between 0.55-0.81 micron and the short circuit current was 20.1 mA/sq cm. Finally, the conversion efficiency was 10.7 pct in AM1 under 107 mW/sq cm illumination. M.S.K.

A83-32265

THE PHOTOVOLTAIC ADVANCED RESEARCH AND DEVELOPMENT PROGRAM IN THE UNITED STATES

J. L. STONE, D. W. RITCHIE, T. SUREK, and C. E. WITT (Solar Energy Research Institute, Golden, CO) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 628-637. Research supported by the U.S. Department of Energy. refs

A83-32266

INFLUENCE OF PLASMA SI-NITRIDE DEPOSITION ON THE DARK I-V CURVES OF MIS CONTACTS FOR INVERSION LAYER SOLAR CELLS

R. SCHOERNER and R. HEZEL (Erlangen-Nuernberg, Universitaet, Erlangen, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 638-642. refs

A83-32267

LIMITATIONS OF THE OPEN CIRCUIT VOLTAGE OF INDUCED JUNCTION SILICON SOLAR CELLS DUE TO SURFACE RECOMBINATION

R. GIRISCH, R. P. MERTENS, and R. VAN OVERSTRAETEN (Leuven, Katholieke Universiteit, Heverlee, Belgium) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 643-647. Research supported by the European Community. refs

Surface recombination under the positively charged insulator between the grating fingers in an induced-junction grating-type solar cell is theoretically and experimentally investigated. A model for recombination at an inverted surface using generalized equations is developed and the impact of the fixed insulator charge, of the nature and distribution of interface states, and of cross sections on the recombination current and the resulting open-circuit voltage of the cell is studied. Experimental evidence for the model was obtained from a grating-type cell with a semitransparent electrode surrounding the grating emitter. It is concluded that surface recombination may become a limiting mechanism in reaching high V_{oc} , but that high V_{oc} are possible provided a proper combination of insulator charge and interface state density is chosen. C.D.

A83-32268

SOME COMMENTS ON SPRAYED ITO/SEMICONDUCTOR SOLAR CELLS

J. C. MANIFACIER, H. LUQUET, L. GOUSKOV, C. GRIL, A. OEMRY, and A. CHAOUI (Montpellier II, Universite, Montpellier, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 648-653. refs

Using a very simple spray technique, photovoltaic devices have been obtained with Si, InP, and CdTe. For Si and InP substrates, the photovoltaic performances are comparable to those of homojunctions. The technique involves spraying a solution of SnCl₄ and InCl₃ onto a heated substrate under a steady nitrogen flux, resulting in chemical reaction which lead to ITO deposition. The ITO layer is characterized by ease of preparation, low cost, and low temperature processing. It is an integral part of the barrier, acts as a protective coating, and also can act as an antireflecting layer. C.D.

A83-32269

ROLE OF PHOTOLUMINESCENCE IN THE EFFICIENCY OF A Ga(1-x)Al(x)As-GaAs SOLAR CELL

P. BARUCH and M. CUNYOT (Ecole Normale Supérieure, Paris, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 654-658. refs

The contribution to the photocurrent of the photoluminescence induced in the 1.4 eV-2.8 eV gap Ga(1-x)Al(x)As front layer of a Ga(1-x)Al(x)As-GaAs cell is studied. The collection efficiency of a heterojunction with a GaAs base and Ga(1-x)Al(x)As front layer is computed. The different processes resulting from the incidence of photons on the front layer are modelled as a function of the thickness of the front and base layer, of diffusion lengths, front surface recombination velocity, and radiative efficiency. The contribution to the photocurrent from the base and front, from recombination-generated photons, and from direct incoming photons are separately calculated. The discussed design permits a thick front layer while retaining a high collection efficiency. C D.

A83-32270

OPERATING CHARACTERISTICS OF THIN THERMOPHOTOVOLTAIC CELLS WITH MINORITY CARRIER MIRRORS AND OPTICAL MIRRORS USING SELECTIVE RADIATORS OF ERBIUM AND YTTERBIUM OXIDES

E. S. VERA, J. J. LOFERSKI, M. SPITZER (Brown University, Providence, RI), and J. SEVERNS (U.S. Navy, Naval Research Laboratory, Washington, DC) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 659-665. Navy-supported research. refs

A83-32271

LAMBERTIAN ANALYSIS OF MIRRORS AND FRESNEL LENSES FOR SOLAR CONCENTRATION

A. LUQUE and E. LORENZO (Escuela Técnica Superior de Ingenieros de Telecomunicación, Madrid, Spain) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 666-670. refs

Concentrators for extended sources useful for tracking and quasistatic applications are analyzed, based on the idea that maximum energy is cast on the collector if the concentrator illuminated by the source becomes a Lambertian source. It is shown that the achievement of this condition is not compatible with the condition of casting all the energy entering the concentrator on the collector. Different concentrator analyses based on these principles are presented. C D.

A83-32272

750 SUNS CONCENTRATOR MODULES USING GaAs SOLAR CELLS

E. FANETTI, C. FLORES, G. GUARINI, and F. PALETTA (Centro Informazioni Studi ed Esperienze S.p.A., Milan, Italy) IN: Photovoltaic Solar Energy Conference, proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 671-676.

The feasibility of very high concentrator modules using GaAs and GaAlAs solar cells is demonstrated both with a single cell and tandem cell configurations. Two small 750 suns concentrator modules were constructed. One module utilized single GaAs cells, Fresnel lens, and passive cooling; the other employed a split spectrum approach and active cooling in order to increase the conversion efficiency. In the latter module, GaAs and GaAlAs cells were combined with optical filters transmitting the high energy portion of sunlight to the high bandgap GaAlAs cell and the low energy portion to the other cell. The characteristics of the module components are shown and described. Tests under solar illumination of 74 mW/sq cm indicated an average current of 9.35 A for the GaAs cells and of 8.1 A for the GaAlAs cells in spectrum splitting configuration. C D.

A83-32273

A 500 WPK PHOTOVOLTAIC CONCENTRATOR USING A GLASS LAMINATED METAL MEMBRANE REFLECTOR

W. HAAF (Schlaich und Partner, Stuttgart, West Germany) and K. HAGENLOCHER (Zeppelin-Metallwerke GmbH, Friedrichshafen, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 677-681.

A 3 m diameter parabolic dish has been constructed. The reflector shape has been chosen such as to give a most homogeneous intensity distribution for a geometric concentration ratio of ≈ 50 . As converter a C50 generator using new monocrystalline Si concentrator cells has been developed. The system is placed in polar position and tracked by driving one axis. The generator drives a consumer water pump and feeds two batteries as a buffer storage for tracking, closed water circuit cooling, and electronic control. Outdoor tests have been started. Author

A83-32274

FLUORESCENT PLANAR CONCENTRATOR (FPC) MONTE-CARLO COMPUTER MODEL LIMIT EFFICIENCY AND LATEST EXPERIMENTAL RESULTS

K. HEIDLER, A. GOETZBERGER, and V. WITTEW (Fraunhofer-Institut fuer Solare Energiesysteme, Freiburg im Breisgau, West Germany) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 682-686. refs

A Monte Carlo computer model for simulation and optimization of fluorescent concentrators is described. The program calculates absolute efficiencies 'ab initio'. The input parameters include solar spectrum, dye absorption and emission spectra, dye quantum yield, dye concentration, collector length and thickness, refractive index, and back reflector characteristics. The output is a detailed analysis of collector processes. The agreement between experiment and simulation is good. Power flow diagrams and optimization characteristics for single sheet collectors and collector stacks are discussed. It is shown that stacking of up to three sheets does not degrade the concentration ratio and enhances optical efficiency compared to the best single-sheet collector. Nine percent electrical efficiency at an optical concentration ratio of 10 seems to be attainable with a realistic-ideal three-sheet collector stack. C D.

A83-32275

PHYSICAL LIMITATIONS OF PRESENT THIN FILM SOLAR CELLS

Y. MARFAING (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts-de-Seine, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 688-697. refs

A comparison is made between the various thin film solar cells by stressing the physical factors which limit their present performances. A general diagram is drawn up on which each cell is localized by two coordinates: one is relative to photocurrent generation, the other is indicative of diode rectifying properties. These aspects are detailed by considering the diode saturation current, the electron-hole pair collection length and the curve filling factor in a unified way which makes use of reference values. The efficiency limitations are thus precisely pointed out and the possibilities of future improvements are discussed. Author

A83-32276

8 PERCENT EFFICIENCY A-SiC:H/A-Si:H HETEROJUNCTION SOLAR CELLS

Y. TAWADA, K. TSUGE, M. KONDO (Osaka University, Toyonaka, Japan), K. NISHIMURA, H. OKAMOTO, and Y. HAMAKAWA IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 698-703. refs

The optical and optoelectronic properties, IR spectra and chemical bonding structure, and photovoltaic performances of

methane-based and ethylene-based a-SiC:H/a-Si:H films and heterojunction solar cells are discussed. The methane based solar cell shows a larger short-circuit current density than the ethylene-based one. IR absorption analysis shows that the methane-based film is a rather ideal amorphous SiC alloy in contrast to the ethylene-based one, which has an organosilane-like structure. The collection efficiency of the ethylene-based cell is relatively smaller than that of the methane-based one. The latter has been used to break the eight percent efficiency barrier for the first time. It is found that wide-gap amorphous materials are not always useful as a window side junction material and that the structure of these materials is an important factor for junction formation C.D.

A83-32277

AMORPHOUS SILICON SOLAR CELLS PRODUCED BY A CONSECUTIVE, SEPARATED REACTION CHAMBER METHOD

Y. KUWANO, M. OHNISHI, S. NAKANO, T. FUKATSU, H. NISHIWAKI, and S. TSUDA (Sanyo Electric Co., Ltd., Research Center Hirakata, Osaka, Japan) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 704-708. Research supported by the Agency of Industrial Science and Technology. refs

A new consecutive, separated reaction chamber method has been developed for the preparation of a-Si films in which each of the p, i, and n layers is deposited in a separated reaction chamber. The method avoids the undesirable doping caused by residual dopant gases which remain in the reaction chamber. The method is briefly described, and the dark conductivity and its temperature dependence of the i-layer subjected to the method are determined. The impurity profile of a-Si device prepared by the method and the influence of residual gaseous dopants on the collection efficiency spectrum and the illuminated I-V characteristics of the cells are examined. The photovoltaic performance of the cells is also studied. The new method exhibits superior doping efficiency and impurity distribution characteristics. The best conversion efficiency of cells prepared by this method is 8.15 percent and 6.35 percent in sunlight of 100 mW/sq cm, where cell size is 2 mm x 2 mm and 10 cm x 10 cm, respectively C.D.

A83-32278

CHARGE COLLECTION IN A-Si:H SOLAR CELLS

G. MUELLER, G. MUECK, M. SIMON, and G. WINTERLING (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 709-713. refs

The performance of p-i-n and Schottky barrier cells is investigated as a function of intrinsic layer thickness, up to 2.5 microns. The main result is that the efficiency of p-i-n/ITO cells is limited by the extraction of photo-generated holes. The hole (μ)(τ)-product is determined from the saturation of the photocurrent with increasing reverse bias. The intrinsic-layer-thickness dependence of the hole (μ)(τ)-product indicates that charge collection in a-Si:H is severely limited by surface- and interfacial effects. Author

A83-32279

THE EFFECT OF GLOW DISCHARGE EXCITATION FREQUENCY ON THE PERFORMANCE OF MICROCRYSTALLINE Si:H THIN FILMS AND DEVICES

R. R. GAY, D. L. MOREL, D. P. TANNER, D. KANANI, and S. ULLAL (ARCO Solar, Inc., Chatsworth, CA) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 714-718.

The effect of excitation frequency on intrinsic material properties of alloys of Si and H prepared by the glow discharge decomposition of SiH₄ is examined, and the influence of processing methodology on thin-film solar cells prepared with such alloys is studied. Measurements made on intrinsic materials indicate that electron

mobility increases with decreasing excitation frequency. Measurements on cells indicate no systematic change in hole properties with frequency, showing that the conduction band is the main material property affected by excitation frequency. Device performance is found to be very sensitive to exposure of the incomplete structure to the atmosphere. The n-i interface is found to be sensitive to the frequency at which the intrinsic layer is deposited. The implications of these observations for device fabrication technology are discussed C.D.

A83-32280

ELECTRODEPOSITED CDS/CDTE HETEROJUNCTION SOLAR CELLS

B. M. BASOL, R. L. ROD, and E. S. TSENG (Monosolar, Inc., Santa Monica, CA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 719-726. refs

A83-32281

THIN FILM HETEROJUNCTION CDS/CU TERNARY ALLOYS SOLAR CELLS WITH MINORITY CARRIER MIRRORS

M. KWIETNIAK, J. J. LOFERSKI, R. BEAULIEU, R. R. ARYA, E. VERA (Brown University, Providence, RI), and L. KAZMERSKI (Solar Energy Research Institute, Golden, CO) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 727-731. NSF-supported research. refs (Contract XI-9-8012-1)

A new concept in the fabrication of thin film solar cells with a multilayer structure in which the base region contains a minority carrier mirror (MCM) is reported. The theory of heterojunctions employing CdS as a wide bandgap window and layers of CuInSe₂ and CuGaSe(0.9)Te(1.1) with MCM as the photovoltaically active semiconductor is presented. A first cell of this type was made by rf-sputtering the successive layers; its AM1 efficiency was about 4 percent. Author

A83-32282

LARGE AREA CDS/CU(X)S THIN FILM SOLAR CELLS PRODUCED BY ELECTROPHORETIC DEPOSITION

T. J. CUMBERBATCH, I. D. MCINALLY, E. W. WILLIAMS, D. J. GIBBONS, M. CLAYBOURN, H. CLOW, P. M. G. DICKINSON (Thorn EMI, Ltd., Central Research Laboratories, Hayes, Middx., England), R. HILL, N. M. PEARSALL (Newcastle Polytechnic, Newcastle-upon-Tyne, England), J. WOODS (Durham, University, Durham, England) et al. IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 732-736. Research supported by the Commission of the European Communities and Department of Industry of England. refs

A83-32283

SPRAYED ZINC-CADMIUM SULFIDE FILMS FOR BACKWALL CU₂S/(Z NCD)S CELLS

V. P. SINGH, M. C. BOST, J. F. JORDAN, and D. M. SPITZER, JR (Photon Power, Inc., El Paso, TX) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 737-741. refs

The properties of Zn(x)Cd(1-x)S films (x = 0-0.5) sprayed on tin oxide coated glass were investigated. The film thickness was found to show little variation with x, while the resistivity increased exponentially with x. It was determined that Cu₂S/Zn(x)Cd(1-x)S cells formed on these films have much lower values for the diode parameter J_{sub 0}, higher open-circuit voltages and values for the diode parameter alpha, and lower values for the short-circuit current density J_{sc} than their CdS counterparts. The spectral response of their short-circuit current was also found to be more sensitive to white light bias than that of the Cu₂S/CdS cell. In addition, photopotential showed a quenching band near 900 nm which accompanied an enhancement band for the open-circuit voltage. N.B.

A83-32284

LARGE AREA AND HIGH EFFICIENCY A-Si:H SOLAR CELL

Y. HIGAKI, M. KATO, M. AIGA, and Y. YUKIMOTO (Mitsubishi Electric Corp., Itami, Japan) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 745-748. Research supported by the Agency of Industrial Science and Technology.

Large area a-Si:H solar cells fabricated by the C-coupled (60 x 60 sq cm parallel plates) glow discharge method were found to have a conversion efficiency of 5.4 percent. It was determined that the inverted (n-i-p/substrate) configuration is superior to the normal (p-i-n/substrate) type for a-Si:H solar cells, since boron atoms are likely to pile up at the interface between the substrate and the a-Si:H even though B₂H₆ gas is not introduced. It is suggested that the undesirable boron atoms come from the susceptor or the side wall of the reaction chamber, which cannot be etched out easily. Calculations are presented for the power dissipation at the transparent conducting film, at the comb electrode, and at the bus electrode on this large area solar cell. A reduction of the loss at the bus electrode resulted in an increase in cell performance with an open-circuit voltage of 0.85 V, a short-circuit current density of 11.5 mA/sq cm, a fill factor of 0.554, and an efficiency of 5.4 percent. N.B.

A83-32285

POST-HYDROGENATED CVD AMORPHOUS SILICON P-I-N DIODES FOR PHOTOVOLTAIC APPLICATIONS

N. SZYDLO, E. CHARTIER, N. PROUST, J. MAGARINO, and D. KAPLAN (Thomson - CSF, Laboratoire Central de Recherches, Orsay, Essonne, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 749-753. Research supported by the Commissariat à l'Energie Solaire. refs

A83-32286

STABILITY OF AMORPHOUS SILICON SOLAR CELLS WITH PIN STRUCTURE

W. KRUEHLER, M. MOELLER, H. PFLEIDERER, R. PLAETTNER, and B. RAUSCHER (Siemens AG, Forschungslaboratorien, Munich, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 754-758. Research supported by the Bundesministerium fuer Forschung und Technologie. refs

A83-32287

CARRIER CONDUCTION IN A-Si:H SOLAR CELLS

M. K. HAN, P. SUNG, R. LAHRI, and W. A. ANDERSON (New York, State University, Amherst, NY) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 759-763. refs

It is found that the conduction process in a-Si:H Schottky structures (I-N+/SS) is barrier controlled at low forward bias (less than 0.2 V) and bulk controlled at large forward bias (greater than 0.6 V). Evidence of space charge limited current conduction (SCLC) in the dark is found in the I-layer. A model incorporating these considerations is developed in order to obtain equations for the terminal I-V characteristics of these structures and to explain the dark I-V characteristics of the P-I-N structure. The dark C-V characteristics of the Schottky structures are also found to support the existence of SCLC conduction in these structures. N.B.

A83-32288

OPTICAL OPTIMIZATION OF AMORPHOUS SILICON SOLAR CELLS

W. DEN BOER and R. M. VAN STRIJP (Delft, Technische Hogeschool, Delft, Netherlands) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 764-768. Research supported by the Stichting voor Fundamenteel Onderzoek der Materie. refs

The optical behavior of thin film solar cells is calculated using a computer simulation study. The application of this method to Schottky-barrier a-Si:H solar cells with highly reflective back contacts shows that multiple reflections are strong for long wavelength light and can be used to improve the efficiency of the cells. Relative maxima in the Am1 integrated absorption are found to occur at certain thicknesses of the a-Si:H film. The optimum antireflection coating is calculated for a given cell configuration. It is also shown that the electron-hole pair generation rate for weakly absorbed monochromatic radiation varies periodically with distance from the front contact due to interference. Calculations for p-n cells, tandem cells, and multi-junction cells can also be obtained using adaptations of this computer program. N.B.

A83-32289

LARGE AREA HYDROGENATED AMORPHOUS SILICON FOR PHOTOVOLTAIC APPLICATION

G. J. SMITH, W. I. MILNE (Cambridge University, Cambridge, England), and P. BLACKBOROW (Plasmatech, Bristol, England) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 769-772. refs

Satisfactory production techniques for depositing hydrogenated amorphous silicon (a-Si:H) over large areas remain to be developed. This paper reports the manufacture of uniform films of a-Si:H by glow discharge of silane over an area 60 cm in diameter. Electrical and optical properties and film quality are discussed. Author

A83-32290

NOVEL PLASMA CHEMICAL METHODS FOR DOPING A-Si:H

G. H. BAUER and G. BILGER (Stuttgart, Universitaet, Stuttgart, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 773-777. Sponsorship Bundesministerium fuer Forschung und Technologie. refs

(Contract BMFT-ET-4045-B)

Various methods have been developed for the doping of hydrogenated amorphous silicon prepared by decomposition of silane in a dc-glow discharge or by rf-sputtering in Ar/H₂ mixtures. These methods of dopants in injection into the plasma are based on the interactions of plasma or neutral gas with the surfaces at different temperatures and varying electric potentials (co-sputtering, dc-sputtering, thermally activated injection to the neutral gas, plasma-assisted transport). Various kinds of dopants (In, B, P, Sb, and N) have been injected into the plasma using these methods and have been incorporated into the film partially acting as electronically active donors and acceptors. Analyses of the doping effects and efficiencies by evaluation of the temperature-dependent conductivity and thermoelectric power data are found to show increases in room temperature conductivity up to a factor of 10 to the 8th (up to approximately 0.01/ohm-cm) and decreases in the activation energies for the extended states conduction which indicate the position of the Fermi level to less than 0.2 eV. N.B.

A83-32291

ELECTRONIC PROPERTIES OF DOPED AMORPHOUS SiO(x)

E HOLZENKAEMPFER, J STUKE (Marburg, Universitaet, Marburg, West Germany), and R FISCHER (Telefunken AG, Frankfurt am Main, West Germany) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 778-782 Research supported by the Deutsche Forschungsgemeinschaft. refs

The properties of films of a-SiO(x) H ($x = 0-1$) prepared by a glow discharge of SiH₄-N₂O-mixtures are studied. Results show that the band gap widens at a rate $dE(04)/dx = 1$ eV, while for fixed oxygen content the band gap shrinks upon doping. It is found that this effect sets in at about 1000 ppm B, while this effect is much weaker for P For $x = 0.23$, the maximum values for the dark conductivity are determined to be approximately 0.00003/ohm-cm (B-doping) and approximately 0.00001/ohm-cm (P-doping) N B

A83-32292

ANTIMONY DOPING IN VACUUM DEPOSITED THIN FILM SILICON PHOTOVOLTAIC CELLS

C FELDMAN, F G SATKIEWICZ, N. A BLUM, and K. G HOGGARTH (Johns Hopkins University, Laurel, MD) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 783-787. refs

A method for antimony doping silicon polycrystalline thin films and single crystals has been investigated. The method is compatible with the concept of forming photovoltaic cells completely in a vacuum system. Layers of Sb₂O₃ and Si were deposited either simultaneously or sequentially through masks onto the silicon surface. Heating (e.g. 1100 C, 1 hr) in either an inert atmosphere or oxygen brought about the formation of an SiO(x)-Sb glassy layer and caused Sb to diffuse into the base silicon surface. The oxide complex is then etched off leaving n-type regions on the surface. Reactions of the layers were examined by secondary ion mass spectrometry and X-ray diffraction. Author

A83-32293

PHOTOVOLTAIC PERFORMANCE OF CDS HETEROJUNCTIONS ON POLYCRYSTALLINE SILICON

E SCAFE, G MALETTA, R TOMACIELLO, P ALESSANDRINI, A CAMANZI, L DE ANGELIS, and F GALLUZZI (ASSORENI, Laboratori di Ricerche, Rome, Italy) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 788-792 refs

Results of research are presented concerning the photovoltaic performance of n-CdS/p-Si heterojunctions. The properties of In doped CdS films, the influence of Si substrate structure, and the role of interfacial oxide layers are investigated. The results of these studies are employed to obtain conversion efficiencies up to 11.1 percent for single crystal Si and 9.2 percent for semi-crystal Si. It is concluded that these results indicate that well behaved n-CdS/p-Si heterojunctions represent an intermediate case between ideal abrupt heterojunctions and proper semiconductor-insulator-semiconductor structures. N B

A83-32294

TEMPERATURE DEPENDENCE OF THE IV-CHARACTERISTIC OF CU₂S-CDS THIN FILM SOLAR CELLS AND RELATED PHENOMENA

G H HEWIG, F PFISTERER, and H W SCHOCK (Stuttgart, Universitaet, Stuttgart, West Germany) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 793-797 Sponsorship Bundesministerium fuer Forschung und Technologie refs (Contract BMFT-ET-4045-B)

A83-32295

CONTINUOUS DEPOSITION OF PHOTOVOLTAIC GRADE CDS SHEET AT THE UNIT OPERATIONS SCALE

R. E ROCHELEAU, P J LUTZ, D. F BRESTOVANSKY, B N BARON, and T W. F. RUSSELL (Delaware, University, Newark, DE) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 798-803 Research supported by the Chevron Research Co. refs

The properties of uniform photovoltaic grade CdS sheet that has been reproducibly deposited on a continuously moving flexible substrate in a reel to reel vacuum coater are investigated. Materials characterization of the CdS sheets by scanning electron microscopy, photoluminescence, and resistivity shows that continuously deposited CdS is essentially equivalent to material that was deposited for making high efficiency Cu₂S/CdS cells in the laboratory scale process. It is found that cells made using continuously deposited CdS sheet had efficiencies as high as 7.85 percent. N B

A83-32296

CU(X)S(P)-CDZNS(N)-CDS(N+) EVAPORATED THIN FILM SOLAR CELLS

B BOUCHIKHI, S CHANDRASEKHAR, F Z NATAREN, and S MARTINUZZI (Aix-Marseille III, Universite, Marseille, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 804-808 Research supported by the Centre National de la Recherche Scientifique and Commission of the European Communities refs

It is shown that the orientation and size of crystallites may be improved in Cd(1-y)Zn(y)S films when they are condensed on a CdS layer previously deposited in the same vacuum provided that the ZnS concentration y does not exceed 12 percent. Backwall cells were obtained using the solid state reactions for different ZnS concentrations. Results show that the photovoltage increases with ZnS concentration y, while very little change occurs for the photocurrent when y values are in the range 0-0.12. Recombination tunneling currents are determined to continue the domination of the current transport mechanism. Light beam induced current scanings are found to indicate that the photoresponses of the cells are quite homogeneous. N B

A83-32298

AIRLESS SPRAYED CDS SOLAR CELLS

J VEDEL, B THIEBAUT, and M. LEVART (Ecole Nationale Supérieure de Chimie, Paris, France) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D Reidel Publishing Co., 1982, p. 818-821

A novel CdS solar cell production technique is presented, and its results are assessed. The apparatus employed by this method incorporates an airless spray gun which allows the use of a more concentrated solution, as well as a decrease in process heating energy requirements. Laboratory-scale results are compared with those obtained by means of conventional techniques. Photovoltaic cells were prepared by means of the dipping process, yielding a cuprous sulfide sufficiently far from stoichiometry for a copper layer to be vacuum-deposited at the end of the dipping operation. Cell energy conversion efficiency after treatment was found to be 5.2 percent. O C

A83-32299

ELECTROCHEMICAL PREPARATION AND CONDITIONING OF CU₂S FOR CU₂S-CDS SOLAR CELLS

J. VEDEL, P COWACHE, and D LINCOT (Ecole Nationale Supérieure de Chimie, Paris, France) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 822-826. Sponsorship European Economic Community refs (Contract EEC-ESC-040-F)

A83-32301**PHOTOVOLTAIC BEHAVIOUR OF CDSE THIN FILM SOLAR CELLS**

E. RICKUS (Battelle-Institut, Frankfurt am Main, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 831-835. Research sponsored by the Commission of the European Communities refs

The high visible light absorption coefficient of CdSe allows the fabrication of solar cells whose thickness is of the order of 1-2 microns. Currently produced by conventional vacuum evaporation processes, such cells exhibit conversion efficiencies above 6 percent. The surface barrier in CdSe can be positively influenced by the insulator layer, by the contact material, and by the irradiation of the cells with photons of an energy greater than 3.5 eV. The stability tests presently reported have demonstrated that the resulting structures are highly insensitive to humidity. Shelf storage for over one year, and even water immersion, does not adversely affect the unsealed cells O.C.

A83-32304**ZN3P2 THIN-FILM SOLAR CELLS**

M. BHUSHAN (Delaware, University, Newark, DE) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 844-847. Research supported by the U.S. Department of Energy. refs

After using close spaced vapor transport to deposit thin polycrystalline films of Zn3P2 on metallized mica substrates, Mg-Zn3P2 Schottky barrier solar cells were prepared by depositing a thin, semitransparent film of Mg by means of dc sputtering. Comparisons of these cells with those fabricated on single-crystal Zn3P2 indicate no significant influence of the presence of grain boundaries on the light-generated current and the open circuit voltage. An n-p junction was formed by heating the present cells in air at more than 500 C, together with the diffusion of Mg in the Zn3P2. A 10 sq cm thin film cell of the present composition has achieved a conversion efficiency of 4.3 percent under simulated AM-1 illumination. O.C.

A83-32305**CADMIUM SULFIDE POLYACETYLENE PHOTOVOLTAIC HETEROJUNCTION**

M. CADENE, M. ROLLAND, M. ALDISSI, and M. ABADIE (Montpellier II, Universite, Montpellier, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 848-852. refs

Attention is given to the use of doped polyacetylene films with insulating, semiconducting and metallic behavior to produce organic semiconductors whose optical transport properties, low cost, and ease of polymerization over large surfaces, strongly suggest their application to novel solar cell designs. Results are presented for tests on thin film heterojunction n-CdS-p-(CHA-y)x compositions. Both dark and illuminated condition I-V characteristics at various temperatures, as well as C-V characteristics, are noted. An 0.5 percent efficiency was obtained under AM-1 lighting conditions. O.C.

A83-32307**PROGRESS IN UNCONVENTIONAL CRYSTALLIZATION OF SILICON**

E. SIRTIL (Heliotronic GmbH, Burghausen, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 858-867. Sponsorship: Bundesministerium fuer Forschung und Technologie refs (Contract BMFT-NT-0845-0846)

The development status of advanced crystallization methods applicable to the production of silicon photovoltaic cells is considered, with a view to their potential for industrial scaling and high material quality reproducibility. Emphasis is given to the factor

of compatibility between refining and crystallization concepts. Economic improvements are reported for the Czochralski-pulling and vertical float-zoning bulk crystallization methods, and attention is given to material synthesis through bulk segregation, semiconductor ribbon growth through pulling and foil casting, and comparisons between the performance of ingot technology and sheet technology industrial processes for solar cell production. O.C.

A83-32310**ADVANCED SLICING TECHNIQUES**

P. G. WERNER (Bremen, Universitaet, Bremen, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 883-895. refs

Silicon wafer mass production of solar cell applications requires slicing techniques that can increase removal rates, while offering high material yields, small kerf losses, good work surface quality, and automated operation. In the present comparative investigation, an assessment is made of machine and tooling features, the mechanical aspects of material removal, projected removal rates, tool wear, and production costs for alternative slicing techniques. Advances in internal diameter sawing and multiblade slurry sawing are emphasized. Cutting rates of up to 2.0 cm/min/blade are obtainable. O.C.

A83-32311**CONTINUOUS GROWTH OF THIN POLYSILICON SHEETS ON A TEMPORARY CARBON SHAPER BY THE R.A.D. PROCESS**

C. TEXIER-HERVO, M. MAUTREF, C. BELOUET, and E. KERRAND (Compagnie Generale d'Electricite, Centre de Recherches, Marcoussis, Essonne, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 896-900. Research supported by the Commission of the European Communities and Commissariat a l'Energie Solaire. refs

The continuous growth of 5 cm-wide polycrystalline silicon ribbons, at pulling rates of up to 8 cm/min, has been demonstrated for the case of a novel RAD process puller equipped with a melt replenishment line. The previous RAD process drawback posed by the carbon shaper's contamination of the metal has been overcome through the use of graphite ribbon carbon shapers which have been purified in chlorine at high temperatures. The carbon shaper is burned off after completion of solar cell growth. AM-1 conversion efficiencies in the 9-11 percent range are obtained. O.C.

A83-32313**LOW COST PROCESSES FOR CAST SILICON SOLAR CELLS**

K.-D. RASCH, K. ROY, W. SCHMIDT, and G. WAHL (Telefunken AG, Heilbronn, West Germany) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 919-925. Research supported by the Bundesministerium fuer Forschung und Technologie.

Roy and Pschunder (1980) have demonstrated the feasibility of a large-scale production of terrestrial solar cells, taking into account an employment of unconventional multigrain cast silicon. For the improvement of long-term prospects in the multimewatt range a low-cost manufacturing process is needed. One possible approach to the development of such a process involves the use of thick film technology conventionally employed in the production of microcircuits. The present investigation is concerned with the feasibility of such an approach for the design of automated silicon solar cell fabrication procedures. Attention is given to junction formation, contact metallization, antireflective layer coating, cell properties, and possibilities for improving the efficiency of cast silicon solar cells. G.R.

A83-32314

POLYCRYSTALLINE SILICON SOLAR CELLS UTILIZING AN INTEGRAL SCREEN PRINTING TECHNIQUE

G. CHEEK, R. JANSSENS, M. LEEMPOELS, L. FRISSEON, R. MERTENS, and R. VAN OVERSTRAETEN (Leuven, Katholieke Universiteit, Heverlee, Belgium) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 926-930. Research supported by the Nationaal Fonds voor Wetenschappelijk, Onderzoek, European Economic Community refs
(Contract EEC-ESC-R-018-B-(G))

Studies reported by Haigh (1976) and Frisson et al (1978) indicate that a screen printing process represents an attractive possibility for the fabrication of silicon solar cells. Investigations related to the implementation of such a process for potentially low-cost silicon material were conducted. Yoo et al (1981) have evaluated low-cost silicon materials, taking into account a use of conventional processing technology. The present investigation is concerned with silicon materials similar to those considered by Yoo et al. However, the employment of nonconventional, low-cost cell processing techniques is explored. Attention is given to cell processing, and a comparison of three potentially low-cost materials with respect to their suitability for the integral screen printing process. G R

A83-32315

PHOTOVOLTAIC SOLAR CELL COMPARISON METHODOLOGY

A. M. BARNETT (Delaware, University, Newark, DE) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 931-937. refs

A description is presented of a consistent basis for the analysis of cost and performance of solar cells, taking into account manufacturing information and measured materials parameters. The considered analysis procedure is applied to three crystalline silicon configurations and two thin film configurations. It is found that the advanced ingot technology should continue to dominate the crystalline silicon approaches and the market for the rest of this decade. In case long-term durability can be demonstrated, a thin film approach could begin to become predominant by the end of the decade. The reliability of the thin film technique product will be more important than ultimate efficiency in the short term. Accordingly, amorphous silicon appears to be favored, if its durability can be demonstrated. In the longer term the CdS-based thin films show the promise of higher efficiencies. New approaches which show significant potential include thin film crystalline silicon, thin film gallium arsenide, and tandem (multijunction) solar cells. G R

A83-32316

SOLAR GRADE FLOATING-ZONE SILICON

A. LUDSTECK and H. J. FENZL (Siemens AG, Munich, West Germany) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 946-954.

An economic use of photovoltaic solar energy on a large scale depends on the availability of low-cost solar silicon and a high efficiency regarding the conversion of sunlight into electrical energy. Metallurgical grade silicon meets the cost requirements. However, its impurity level in the 1 percent range is far too high for a use in solar cells. Suitable approaches for purifying metallurgical grade silicon are investigated, taking into account float-zone (FZ) growth and Czochralski (CZ)-pulling. The reduction of the impurity level by FZ and CZ techniques is compared for each individual impurity. The remaining impurity concentration is below 1 percent in the case of float zone growth, while the corresponding value is more than 50 percent for CZ pulling. At the present time more than one zone pass is necessary for an appropriate crystallization of metallurgical grade silicon. Parameters and direct production cost of solar grade monocrystalline silicon are presented in a table, taking into account the FZ and the CZ process. G R

A83-32317

CURRENT ASPECTS OF THE C.G.E. SEMICRYSTALLINE SILICON INGOTS ELABORATION METHOD

J. FALLY and C. GUENEL (Compagnie Generale d'Electricite, Centre de Recherches, Marcoussis, Essonne, France) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 955-959. Research supported by the Commissariat a l'Energie Solaire and Commission of the European Communities refs

Fally and Guenel (1980) have conducted a study regarding the feasibility of producing semicrystalline silicon ingots by means of a unidirectional crystallization process in a crucible, taking into account the employment of a fast variant of the Bridgman process. The obtained material was found to be suitable for the manufacture of solar cells with a reasonably good photovoltaic efficiency. The weight of the silicon blocks was about 1 kg. The main limitations of this material were related to crystallographic imperfections and the relatively high bulk-grain impurity content introduced by the crucible walls. The present investigation represents a continuation of the earlier study. The investigation is concerned with the design and construction of an industrial prototype furnace which permits the adaptation of the directional solidification process to the production of 25 kg ingots of semicrystalline silicon. A second objective is the optimization of the characteristics of the silicon. G R

A83-32318

AN APPROACH TO SOLAR GRADE SILICON LAYERS EPITAXIALLY GROWN ON MG SILICON SUBSTRATES

V. SCHLOSSER, F. KUCHAR, and K. SEEGER (Ludwig Boltzmann Institut fuer Festkoerperphysik, Wien, Universitaet, Vienna, Austria) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 960-964. Research supported by Shell Austria AG, Forschungsfoerderungsfonds der Gewerblichen Wirtschaft and Bundesministerium fuer Wissenschaft und Forschung refs

An investigation was conducted by Schmid et al (1980) concerning the performance of solar cells made by utilizing a metallurgical grade (MG) silicon substrate. Cells made by a technique involving an epitaxial growth on the substrate were found to be superior to cells made with the aid of a diffusion process. Requirements for the substrate are related to good crystallinity, and the necessity to reduce the diffusion of impurities from the substrate into the epitaxial layer to an acceptable level. Two approaches are considered to meet these requirements. One approach involves the employment of very thin substrates (thickness in the same range as that of the deposited layer). The second approach includes the removal of a large amount of fast diffusing impurities. Experiments were conducted with substrates prepared from single crystal silicon, polycrystalline silicon, and MG silicon. A chemical vapor deposition (CVD) process was used. Attention is given to a-Si gettering of MG-Si substrates, the gettering of Au by a-Si in single crystal substrates, and the effect of -Si gettering. G R

A83-32319

METHOD OF RAW MATERIAL CONTINUOUS FEEDING ON SILICON RIBBON GROWTH

N. MAKI, T. SAWADA, M. IIDA, T. MATSUI, K. TAMAI, and M. NAKAGAWA (Toshiba Corp., Electron Device Engineering Laboratory, Kawasaki, Japan) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 965-969. Research supported by the Ministry of International Trade and Industry refs

The ribbon crystal pulling method has the potential for making a reduction in the cost of solar cells possible. A description is presented of a continuous process for the production of silicon ribbon, taking into account the manufacture of a ribbon of 94 mm in width and 0.5 mm in thickness. The apparatus used for the continuous feeding process consists of three components, including

the feeding device, the feed rate controller, and the liquid level sensor. The feeding device supplies granular silicon to the crucible. The liquid level sensor controls the level of the molten silicon. The continuous removal mechanism employs a laser cutting device and a ribbon transfer device. Continuous pulling is accomplished with the aid of a roller drive mechanism. The problem of air leakage into the furnace was solved by employing a gas curtain mechanism
G R.

A83-32320
IMPURITY INCORPORATION IN R.A.D. POLYSILICON LAYERS AND CONSEQUENCES ON THEIR ELECTRICAL PROPERTIES

G. REVEL, N. DESCHAMPS (Commissariat à l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, Essonne, France), J. P. DEVILLE (Strasbourg I, Université, Strasbourg, France), C. TEXIER-HERVO, and C. BELOUET (Compagnie Generale d'Electricite, Centre de Recherches, Marcoussis, Essonne, France) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 970-975. Research supported by the Commission of the European Communities and Commissariat à l'Energie Solaire refs

The growth of polysilicon layers by direct freezing of a silicon film on a carbon ribbon by the RAD (ribbon against drop) process has been studied in connection with the objective to obtain low-cost solar cells. Difficulties concerning an employment of this process are related to a contamination of the layers by carbon and its compositional impurities. This contamination may represent a severe limitation to the performance of the solar cells made from the considered material. The present investigation is concerned with a comprehensive study of the contamination effects in material produced by the RAD process, taking into account the incorporation of impurities during the growth process and the consequences of this incorporation on the performance of solar cells. Attention is given to the use of neutron activation analysis (NAA), the employment of gamma-spectroscopy, and impurity surface analyses
G R.

A83-32321
FAST SILICON-SHEET GROWTH WITH THE SUPPORTED-WEB METHOD

J. G. GRABMAIER, H. FOELL, B. FREIENSTEIN, and K. GEIM (Siemens AG, Munich, West Germany) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 976-979. Research supported by the Bundesministerium fuer Forschung und Technologie refs

Directly grown silicon ribbons or sheets may provide an attractive alternative to single-crystal silicon wafers for the manufacture of low-cost solar cells. A serious disadvantage of ribbon growth techniques, however, is related to the rather small areal growth rates obtained in most cases. The areal growth rates are usually below 100 sq cm/min, while values of 500 sq cm/min, are provided by the conventional Czochralski technique. The growth-rate limiting factor in all cases is the removal of the heat of crystallization from the liquid-solid interface. A completely new technique with the potential of very high areal growth rates is the 'supported-web (S-Web)' technique. The present investigation provides preliminary results obtained in a current study of this technique. In connection with the implementation of this method, a net of carbon fibers is pulled through a crucible containing liquid silicon. A liquid web of silicon is spread out within the meshes of the net. It is kept stable by the high surface tension of the liquid silicon.
G R.

A83-32322* Crystal Systems, Inc., Salem, Mass.

RECENT DEVELOPMENTS IN MULTI-WIRE FIXED ABRASIVE SLICING TECHNIQUE (FAST)

F. SCHMID, C. P. KHATTAK, M. B. SMITH, and L. D. LYNCH (Crystal Systems, Inc., Salem, MA) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 980-984. Research sponsored by the U.S. Department of Energy and NASA refs

Slicing is an important processing step for all technologies based on the use of ingots. A comparison of the economics of three slicing techniques shows that the fixed abrasive slicing technique (FAST) is superior to the internal diameter (ID) and the multiblade slurry (MBS) techniques. Factors affecting contact length are discussed, taking into account kerf width, rocking angle, ingot size, and surface speed. Aspects of blade development are also considered. A high concentration of diamonds on wire has been obtained in wire packs used for FAST slicing. The material removal rate was found to be directly proportional to the pressure at the diamond tips.
G R.

A83-32323* Jet Propulsion Lab., California Inst. of Tech., Pasadena

CRITICAL TECHNOLOGY LIMITS TO SILICON MATERIAL AND SHEET PRODUCTION

M. H. LEIPOLD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 985-989. Research sponsored by the U.S. Department of Energy and NASA refs

Earlier studies have indicated that expenditures related to the preparation of high-purity silicon and its conversion to silicon sheet represent from 40 to 52 percent of the cost of the entire panel. The present investigation is concerned with the elements which were selected for study in connection with the Flat-Plate Solar Array (FSA) Project. The first of two technologies which are being developed within the FSA Project involves the conversion of metallurgical-grade silicon through a silane purification process to silicon particles. The second is concerned with the conversion of trichlorosilane to dichlorosilane, and the subsequent production of silicon using modified rod reactors of the Siemens type. With respect to silicon sheet preparation, efforts have been focused both on the preparation of ingots, followed by wafering, and the direct crystallization of molten silicon into a ribbon or film.
G R.

A83-32324
ECONOMIC VIABILITY OF THE UCP SEMICRYSTALLINE SILICON SHEET TECHNOLOGY

Z. PUTNEY, T. ROSENFELD, and C. WRIGLEY (Semix, Inc., Gaithersburg, MD) IN Photovoltaic Solar Energy Conference, Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982. Dordrecht, D. Reidel Publishing Co., 1982, p. 990-993 refs

(Contract DE-FC01-80ET-23197)

Lindmayer (1976) has reported the initial results of a new approach to the generation of silicon sheet for photovoltaic applications. The approach was named the Ubiquitous Crystallization Process (UCP) and the obtained product is called semicrystalline silicon. The term semicrystalline is employed to differentiate the middle ground between single-crystal material and fine-grained polycrystalline forms. A lower-purity silicon approach, termed the Simultaneously Present Large Impurity Technology (SPLIT), was developed to provide a low-cost UCP feedstock. In an economic analysis it is found that the projected cost for modules made with UCP silicon can closely approach \$0.50/Wp with SPLIT silicon feedstock and \$0.60/Wp with \$14/kg feedstock. It is concluded that the UCP semicrystalline silicon sheet technology has the economic viability for low-cost photovoltaics.
G R.

A83-32325

COMPARISON BETWEEN VARIOUS ION BEAM DOPING PROCEDURES AND ANNEAL TECHNIQUES USED IN MANUFACTURING SILICON SOLAR CELLS

J. C. MULLER, A. MESLI, P. SIFFERT (CNRS, Centre de Recherches Nucleaires de Strasbourg, Strasbourg, France), J. COM-NOUGUE, C. TESSARI, and J. P. DUMAS (Compagnie Generale d'Electricite, Centre de Recherches, Marcoussis, Essonne, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p 994-998. Research supported by the Commissariat a l'Energie Solaire and Commission of the European Communities. refs

A83-32328

SILICON SOLAR CELLS BY ION IMPLANTATION - E-BEAM AND SELF ANNEALING

G. F. CEMBALI, R. GALLONI, G. LULLI, A. MAZZONE, P. G. MERLI, R. NIPOTI (CNR, Istituto LAMEL, Bologna, Italy), and F. ZIGNANI (Bologna, Universita, Bologna, Italy) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 1013-1017. Research supported by the European Economic Community and Consiglio Nazionale delle Ricerche. refs

Experiments were performed to examine two techniques for annealing solar cells. P(+) ions were implanted, followed by e-beam annealing using a new electron gun with a beam width that can be varied, thereby eliminating the necessity for scanning. Other trials were run using a 50 W/sq cm ion beam for the implantation, thereby reaching a cell temperature of 1300 C, and the evidence for thermal self-annealing was scrutinized. Furthermore, a computer model was employed to study the effect of emitter tailoring on the cell efficiency. A total of 10 TiAg front grid, Al back contact, TiO₂-SiO₂ solar cells were tested and measured for the differential resistivity and the Hall effect. Self-annealed cells showed a better response to longer wavelengths, enough to offset the higher short-circuit currents available from electron beam annealing. Better I-V curve characteristics were observed after e-beam annealing, which indicated that 15 pct efficient AM1 cells are possible with this technique. The same efficiency is possible with self-annealing if homogeneous implantation can be achieved. M.S.K

A83-32329

LASER PROCESSING IN THE PREPARATION OF HIGH EFFICIENCY POLYCRYSTALLINE SILICON SOLAR CELLS

E. COURCELLE, E. FOGARASSY, J. C. MULLER, and P. SIFFERT (CNRS, Centre de Recherches Nucleaires de Strasbourg, Strasbourg, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 1023-1028. refs

A83-32333

DRY PROCESS FOR ECONOMIC CELL MANUFACTURING

J. DONON, H. LAUVRAY, P. AUBRIL, G. DAVID, and P. LOUBLY (Photowatt International, S.A., Caen, France) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p 1044-1048 Research supported by the Commission of the European Communities.

Plasma dry etching technologies and screen printing processes for the dopant and the contacts were employed in an attempt to develop a completely dry process for solar cell manufacturing. Plasma etching within a barrel reactor produced etch rates of 0.3 and 0.6 micron/min, compared with acid etching rates of 13 microns/min and basic etching rates of 5 microns/min. Ring etching was also carried out in a barrel reactor with 200 wafers positioned in a stack, power levels of 850 W, a CF₄ + 8 pct O₂ plasma, a flow rate of 200 cc/min, and a run time of 15 min. The ring etching process was also tested and proven to have good reproducibility. A doping paste was employed, together with a thermal treatment at 850 C for 1 hr, to obtain good diffusion

homogeneity. The results included cell efficiencies more than half those from chemical etching with both monocrystalline and polycrystalline materials. The techniques are concluded to produce negligible pollution, waste little material, and be amenable to automation. M.S.K

A83-32335

AN IMPROVED DERIVATION OF SOLAR CELL PARAMETERS IN TERMS OF TRANSITION PROBABILITIES

P. T. LANDSBERG (Southampton, University, Southampton, England) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 1056-1058

The equation for the load current density defined by Landsberg (1981) redefined in terms of the downward nonradiative transition rate load current density and the upward rate density. The densities are expressed by means of the radiative and nonradiative transition probabilities per unit time by use of the rate equation and formulations of the quasi-chemical potentials. Further work to broaden the scope of application to three-level systems and to photosynthesis is indicated. M.S.K.

A83-32337

THE WORLD'S LARGEST 12VOLT SINGLE STRING PHOTOVOLTAIC MODULE

PH. LAUWERS and G. R. SMEKENS (Energies Nouvelles et Environnement, S.A., Brussels, Belgium) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 1063, 1064.

Manufacturing steps and physical dimensions of a 12 V single string photovoltaic module are presented. A semicrystalline, 20 cm x 20 cm Si ingot produced by the Semix process was cut to 15 cm x 15 cm size and etched into 500 microns thick wafers. Screen printing and encapsulation were used to finish the cell module, which was completed at a 20 pct reduction in cost compared to the effort necessary for a 10 cm x 10 cm module of the same materials. The cells exhibited a short-circuit current of 5.5 A, an 8 pct efficiency, and a 4.5 A charging current at 16 V. The total module efficiency was 7.2 pct with a maximum power delivery of 72 W under 1 kW/sq m AM1.5 illumination. M.S.K

A83-32339

MICROPROGRAMMED COUPLING SYSTEM FOR PHOTOVOLTAIC GENERATORS WITH MULTIPLE RECEPTORS

G. CHAUMAIN, M. BARLAUD, P. ROUAN, and JP. REQUIER (Dakar, ENSUT, Dakar, Senegal) IN: Photovoltaic Solar Energy Conference; Proceedings of the Fourth International Conference, Stresa, Italy, May 10-14, 1982 Dordrecht, D. Reidel Publishing Co., 1982, p. 1068-1070

The organization, operational guidelines, and storage recommendations for an impedance adaptor-equipped photovoltaic array power system are outlined. The possibility of power losses through defective cells by maintaining the electrical independence of each module and installing automatic power-tracking device controls for each module. The overall distribution is handled by a microprocessor. A chopper is added for dc generator systems, together with a programmable receptor with a static performance adapted to the generator. Impedance adaptation is achieved by a governing algorithm in the microprocessor which adjusts the output in reference to ideal IV curves stored in memory. Storage is used in both a buffer mode, to take care of power transients, and to compensate for the changing nature of renewable energy sources. The system presented is also recommended for use with wind turbines and other electricity generation equipment. M.S.K.

A83-32348

THEORETICAL AND EXPERIMENTAL ASPECTS OF A TWO-STEP SHORT CYCLE, BASED ON ZNO AND CDO INTENDED FOR STORAGE OF SOLAR ENERGY

M. COMTAT (Toulouse III, Université, Toulouse, France), M. DUCARROIR, F. SIBIEUDE (CNRS, Laboratoire des Ultra-Refractaires, Font-Romeu, Pyrénées-Orientales, France), G. CROZAT, and B. SPINNER (Perpignan, Université, Perpignan, France) International Journal of Energy Research (ISSN 0363-907X), vol. 7, Apr.-June 1983, p. 137-153. Research supported by the Centre National de la Recherche Scientifique. refs

A83-32349

A SIMPLIFIED THEORY FOR A MATRIX SOLAR COLLECTOR

D. SINGH and N. K. BANSAL (Indian Institute of Technology, New Delhi, India) International Journal of Energy Research (ISSN 0363-907X), vol. 7, Apr.-June 1983, p. 173-177

In this note we present a simple generalized analysis for a matrix collector and obtain closed form solutions for the equations. Numerical calculations were performed corresponding to the experimental data of Chau and Henderson. Author

A83-32350

ENERGY BALANCE OF SOLAR ABSORPTION AND VAPOR COMPRESSION COOLING SYSTEMS

S. AYYASH and R. K. SURI (Kuwait Institute for Scientific Research, Safat, Kuwait) International Journal of Energy Research (ISSN 0363-907X), vol. 7, Apr.-June 1983, p. 187-197. refs

Solar absorption cooling systems are viewed as potential alternatives to fossil-fuel-based conventional cooling systems. This view is investigated in this paper from the point of view of the energy balance of solar absorption and conventional systems. The paper investigates the primary energy needs of three cooling systems; dry and wet cooled vapor compression systems and wet cooled solar absorption. The sources of energy demand in the three systems are identified and their primary energy needs determined. The paper, then, investigates the conditions under which the energy inputs to the solar system break even with the other two systems. The investigation is conducted with particular reference to the operational and environmental conditions in Kuwait. Author

A83-32646

PHOTOEFFECT ON SIAS ELECTRODES

H. J. LEWERENZ and H. WETZEL (Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH, Berlin, West Germany) Electrochemical Society, Journal (ISSN 0013-4651), vol. 130, May 1983, p. 1228-1230. refs

The first electrochemical measurements on SiAs are reported. SiAs is a layered semiconductor whose structure and bonding characteristics are different from those of the studied group VI chalcogenides. All experiments were performed in a N₂-saturated sulfate solution. Illumination was provided with the aid of a tungsten-iodine lamp. A photocurrent spectrum of a p-SiAs electrode is shown in a graph. In the long-wavelength region, a relatively small increase of current with photon energy is observed, indicating indirect electron transitions at photon energies near the semiconductor band gap at 1.42 eV. Around 500 nm a shoulder is observed and at 400 nm a steep increase in photocurrent is noted. It is pointed out that the almost ideal energetic location of the SiAs band gap and the low material costs could make this semiconductor a promising candidate for solar energy conversion. G. R.

A83-32670

EFFECT OF HEAT TREATMENT ON THE BULK DIFFUSION LENGTH OF EFG RIBBON SILICON

C. T. HO, G. MOELLER, and J. D. MATHIAS (Mobile Tyco Solar Energy Corp., Waltham, MA) Solid-State Electronics (ISSN 0038-1101), vol. 26, March 1983, p. 247-250. refs

The effect of thermal anneal on the bulk minority carrier diffusion length L(n) of Edge-defined Film-fed Growth ribbon silicon has

been investigated. Statistical distributions of L(n) were gathered after the thermally treated ribbons were fabricated into solar cells by a cold junction formation method (ion implant and pulsed electron beam anneal). The measurements were made by using a bifurcated optical guide arrangement which was specifically designed for ribbon samples with variable surface reflectance. The experimental results indicated that, after a medium temperature (800 °C) thermal anneal in a neutral ambient, the form of the L(n) distribution changed in an overall degradation in the average value. With the same thermal anneal in a gettering ambient, the distribution also altered, but with an overall improvement. The observations are discussed in terms of the interaction of metallic impurities with the local structural and chemical defects contained in the ribbons. Author

A83-32675

ANALYSIS OF A NON-UNIFORMLY DOPED MPN SILICON SCHOTTKY BARRIER SOLAR CELL

S. B. ROY, T. K. SINHA, and A. N. DAW (Institute of Radio Physics and Electronics, Calcutta, India) Solid-State Electronics (ISSN 0038-1101), vol. 26, April 1983, p. 353-359. refs

An analysis of the solar cell properties of an Al-P-N Si Schottky diode has been made assuming a generalized impurity distribution in the P-type doped layer. The effect of the image force potential on the effective barrier height is considered. The effect of a constant built-in field in the substrate has also been included in the analysis. Important solar cell parameters such as open circuit voltage, short-circuit current, and fill factor have been calculated as a function of the impurity concentration in the doped layer and its thickness. It is shown that the efficiency η depends strongly on the nature of the impurity profile, being highest for the Gaussian and lowest for the exponential. Finally, the presence of a built-in field ($E_b = 4.5$ V/cm) in the substrate is found to increase the resultant η which is about 6-8 percent higher than that of a diode without the drift field. Author

A83-32714#

SOLAR POWERED, SELF-REFUELING, MICROWAVE PROPELLED INTERORBITAL TRANSPORTATION SYSTEM

M. A. MINOVITCH (Phaser Telepropulsion, Inc., Los Angeles, CA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 25 p. refs (AIAA PAPER 83-1446)

This paper introduces an economical and comprehensive interorbital transportation system for transporting high mass payloads between low initial orbits and geosynchronous orbits. The system comprises a fleet of space-based, microwave propelled orbiting transfer vehicles, an earth-based microwave transmitter, an orbiting microwave relay satellite and an orbiting air-scooping vehicle which periodically dips into, collects, and liquefies portions of the earth's atmosphere. The microwave transmitter consists of a large multiple dish, beam focusing phased array antenna operating at X-band and fed by several thousand high power microwave generators with a total radiated power exceeding 10 GWs. A relatively low mass, 600 m diameter steerable antenna, mounted onboard the transfer vehicles collects and reflectively concentrates the microwave radiation into a pair of cyclotron resonance plasma accelerators. These accelerators ionize low density nitrogen gas and accelerate it to very high exhaust velocities. The nitrogen working fluid is manufactured in orbit by the air-scooping vehicle. The microwave antenna is utilized as a large solar electric generating plant during the day, and as a large SETI antenna at night when it is not used for propelling transfer vehicles. The electric power generation is sufficiently large such that the entire system can pay for itself within 20 years. Author

A83-32740#

CERAMIC TUBE DEVELOPMENT FOR SOLAR RECEIVER APPLICATIONS

R K MCMORDIE and R H. STERRETT (Martin Marietta Aerospace, Denver, CO) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983, 7 p.

(AIAA PAPER 83-1501)

Thermal tests have been conducted on translucent ceramic solar receiver tubes intended for use with gaseous working fluids at temperatures of approximately 2000 F. The tubes are packed with a steel wool-like material. The test data obtained are correlated with an analytical model, and performance predictions are made for the case of a prototype scaling of the ceramic tube receiver. Test data were obtained for five ceramic tubes and two steel tubes. The translucent ceramic employed is a proprietary alpha alumina, and the steel wool packing material is of type 304 stainless steel. O.C.

A83-32838

8.5 PERCENT EFFICIENT SCREEN-PRINTED CDS/CDTE SOLAR CELL PRODUCED ON A 5-CM X 10-CM GLASS SUBSTRATE

H MATSUMOTO, A. NAKANO, Y KOMATSU, H UDA, K KURIBAYASHI, and S. IKEGAMI (Matsushita Electric Industrial Co., Ltd., Wireless Research Laboratory, Kadoma, Osaka, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol 22, Feb. 1983, p 269-271. Research supported by the Agency of Industrial Science and Technology. refs

The preparation conditions of CdS sintered film for 5-cm x 10-cm screen-printed CsS/CdTe solar cells were investigated. Increasing the belt speed of the belt furnace increased the residual amount of Cl ions in the CdS sintered film and lowered the efficiency of the cell. The optimum belt speed was 2 cm/min, corresponding to a sintering time of 90 min. The thickness of the CdS film was changed by changing the screen thickness. Increasing the thickness of the CdS film lowered its surface resistivity and improved the fill factor of a cell. A solar cell of 8.5 percent intrinsic efficiency was obtained from CdS film printed by an 80 mesh screen and sintered at 690 C at a belt speed of 2 cm/min.

Author

A83-32846

SOLAR COLLECTOR TESTING IN THE EUROPEAN COMMUNITY

W. B. GILLET, J. E. MOON (University College, Cardiff, Wales), and E. ARANOVITCH (Commission of the European Communities, Joint Research Centre, Ispra, Italy) International Journal of Solar Energy (ISSN 0142-5919), vol. 1, no. 5, 1983, p 317-341. refs

Recent work by the Commission of the European Communities Solar Collector Testing Group at the Joint Research Centre in Ispra, Italy, is reviewed. Five test methods for liquid-heating collectors are described. Data scatter in the results of round-robin outdoor thermal-performance tests (performed at each Group-member laboratory) is analyzed in terms of environmental effects not accounted for in the linear performance model, calibration and precision differences, and real differences due to manufacturing variations. Comparative data on solar-irradiance-pyranometer calibration is presented. Solar-simulator test devices are reported to provide reproducible measurements which accord with outdoor results. Preliminary findings of studies of collector durability, including inspection reports, natural aging observations, development of qualification criteria (high-temperature stagnation, rain/wind penetration, absorber internal pressure, and external thermal shock), and round-robin solar-absorptance and thermal-emittance measurements, are presented. Future work will be directed to the testing of air collectors, installed domestic hot-water systems, and high-performance evacuated-tube collectors. T.K.

A83-32847

TECHNOLOGY OF ALL ELECTROPLATED CDS:CU(X)S SOLAR CELLS

A C. RASTOGI and K. S. BALAKRISHNAN (National Physical Laboratory of India, New Delhi, India) International Journal of Solar Energy (ISSN 0142-5919), vol. 1, no. 5, 1983, p. 357-366. Research sponsored by the Tata Energy Research Institute.

Electrolytic deposition of CdS and Cu(x)S for realizing solar cells holds considerable low cost potential. An electrodeposition technique from nonaqueous electrolytes is described and effect of important deposition variables on electrical and structural properties of films is discussed. Heterojunctions in frontwall configuration have been fabricated and the effect of Cu(x)S bath composition on photovoltaic performance is evaluated. $V_{oc} = .412$ V and $I_{sc} = 5.95$ mA/sq cm have been achieved. Author

A83-33675

APPLICATION OF POWER TRANSISTORS TO RESIDENTIAL AND INTERMEDIATE RATING PHOTOVOLTAIC ARRAY POWER CONDITIONERS

R. L. STEIGERWALD, A. FERRARO, and F. G. TURNBULL (General Electric Co., Corporate Research and Development Dept., Schenectady, NY) (Institute of Electrical and Electronics Engineers, International Semiconductor Power Converter Conference, Orlando, FL, May 24-27, 1982) IEEE Transactions on Industry Applications (ISSN 0093-9994), vol. IA-19, Mar.-Apr. 1983, p. 254-267. refs

(Contract DE-AC02-80ET-29310)

Power conditioning systems that interface with photovoltaic arrays are presently investigated for the cases of 5-30 kW residential systems interfacing with a 240-V single-phase utility connection, and 30-200 kW intermediate systems interfacing with a 480-V three-phase utility connection. Both systems require an isolation transformer between the array and the utility interface. A tradeoff study is conducted for numerous transistor and thyristor circuits and configurations, with weighting criteria that include full- and part-load efficiency, size, weight, reliability, ease of control, injected harmonics, reactive power requirements, and parts cost. On the basis of study results, a 10-kW high frequency transistor inverter feeding a high frequency isolation transformer with a sinusoidally shaped current wave was selected. O.C.

A83-33844

DETERMINATION OF DIFFUSION LENGTH OF ELECTRON BEAM INDUCED MINORITY CARRIERS IN POLYCRYSTALLINE GaAs

O. PAZ (IBM East Fishkill, General Technology Div., Hopewell Junction, NY) and J. M. BORREGO (Rensselaer Polytechnic Institute, Troy, NY) Applied Physics Letters (ISSN 0003-6951), vol. 42, June 1, 1983, p. 958-960. refs

(Contract XS-0-9002-4)

A description is presented of a technique which makes it possible to perform a quantitative measurement of the diffusion length concurrently with a qualitative display of the electron beam induced current (EBIC) image. Such an EBIC image can be conveniently employed to define grain clusters and grain boundaries. A Schottky barrier parallel to the electron beam bombarded surface is used, and the depth is varied by varying the electron beam voltage. In order to determine the diffusion length, measurements were conducted of N , the number of collected minority carriers per incident electron. After correcting for backscattered and secondary electrons, N was compared to a calculated value which includes a correction for the thickness of the metal contact. Gold GaAs Schottky barrier solar cells were used in the investigation. G.R.

A83-33847

OPTICALLY ENHANCED AMORPHOUS SILICON SOLAR CELLS

H. W. DECKMAN, C. R. WRONSKI, H. WITZKE, and E. YABLONOVITCH (Exxon Research and Engineering Co., Corporate Research Science Laboratories, Linden, NJ) Applied Physics Letters (ISSN 0003-6951), vol. 42, June 1, 1983, p. 968-970. refs

The first application of optical enhancement to thin-film (about 0.75 microns thick) amorphous silicon solar cells is described, and cell geometries which maximize enhancement effects are defined. Due to the improved infrared absorption, the external AM1 short circuit current increases by 3.0 mA/sq cm in cells constructed in accordance with the principles of optical enhancement. Author

A83-33860

SOLAR ENERGY MATERIALS

Berlin, Springer-Verlag (Structure and Bonding Volume 49), 1982, 190 p.

The papers presented deal with structure and bonding. Topics discussed include luminescent solar concentrators for energy conversion and the visible-light-induced cleavage of water into hydrogen and oxygen in colloidal and microheterogeneous systems. In the latter, particular emphasis is placed on charge separation and kinetic control of the events by organized molecular assemblies, such as micelles and vesicles. Attention is also given to photoelectrochemical energy conversion involving transition metal d-states and the intercalation of layer compounds. C.R.

A83-33861

LUMINESCENT SOLAR CONCENTRATORS FOR ENERGY CONVERSION

R. REISFELD (Jerusalem, Hebrew University, Jerusalem, Israel) and C. K. JORGENSEN (Geneve, Universite, Geneva, Switzerland) IN: Solar energy materials Berlin, Springer-Verlag, 1982, p. 1-36. Research supported by the Ministry of Energy of Israel and U.S. Department of Energy. refs (Contract DOE-80-109)

A description is given on the geographical, seasonal, and spectral distribution of terrestrial solar energy. The concept of nontracking fluorescent concentrators is discussed, together with the mathematical background for the collection and concentration of direct and diffuse light. Attention is also given to single plates, multiple stacks, and thin films doped by one or more colorants. An analysis is presented of the differences between inorganic and organic materials. In addition, suggestions are made for new hybrid systems. C.R.

A83-33863

PHOTOELECTROCHEMICAL ENERGY CONVERSION INVOLVING TRANSITION METAL D-STATES AND INTERCALATION OF LAYER COMPOUNDS

H. TRIBITSCH (CNRS, Laboratoire d'Electrochimie Interfaciale, Meudon, Hauts-de-Seine, France) IN: Solar energy materials Berlin, Springer-Verlag, 1982, p. 127-175 refs

The discussion begins with a treatment of electron transfer, energy conversion, and transition metal d-states. In discussing photoelectrochemical reactions involving holes on d-states, attention is given to the d-band structure of transition metal dichalcogenides, d-d excitation and photoelectrochemical behavior, d-states and the dynamics of the layer-type interface, and photoelectrochemical reactions involving water. Solar energy conversion with d-band semiconductors is then considered, with attention given to the development and performance of regenerative solar cells and to fuel-producing and energy-storing solar cells. Other topics include semimetallic electrode behavior and photoelectrochemical implications, solar energy conversion and storage by intercalated species, and the implications for photoelectrochemical theory and applications. C.R.

A83-33918

USE OF TIN OXIDE AS AN INEXPENSIVE ANTIREFLECTION COATING FOR P ON N POLYCRYSTALLINE SILICON SOLAR CELLS

B. C. CHAKRAVARTY, S. N. SINGH, and B. K. DAS (National Physical Laboratory of India, New Delhi, India) IEEE Electron Device Letters (ISSN 0193-8576), vol. EDL-4, May 1983, p. 138, 139 refs

A83-33919

COMPUTER SIMULATION OF AMORPHOUS SILICON BASED ALLOY P-I-N SOLAR CELLS

M. HACK (Energy Conversion Devices, Inc., Troy, MI) and M. SHUR (Minnesota, University, Minneapolis, MN) IEEE Electron Device Letters (ISSN 0193-8576), vol. EDL-4, May 1983, p. 140-143. Research supported by the Standard Oil Co. refs

A83-33922

EFFICIENCY OF THE A-SI:H SOLAR CELL AND GRAIN SIZE OF SNO₂ TRANSPARENT CONDUCTIVE FILM

H. IIDA, N. SHIBA, T. MISHUKU, H. KARASAWA, A. ITO (Taiyo Yuden Co., Ltd., Technical Laboratory, Haruna, Gumma, Japan), M. YAMANAKA, and Y. HAYASHI (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan) IEEE Electron Device Letters (ISSN 0193-8576), vol. EDL-4, May 1983, p. 157-159. Research supported by the Ministry of International Trade and Industry.

A83-33967

THE PROCESSING OF METALLIC STRUCTURES BY ELECTROPLATING METHODS [FERTIGUNG METALLISCHER STRUKTUREN AUF GALVANISCHEM WEGE]

R. SUCHENTRUNK (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) IN: Highly stressed materials, with aviation considered as an example. Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1982, p. 187-195. In German refs

The use of electroplating to manufacture complex structures of Ni, Ni/Co, Cu, Al, or other metals is illustrated. The method involves the deposition of thick metal layers on a formed core which can remain as part of the finished structure or be removed by chemical, mechanical, or thermal means. The advantages of the technique, which include high precision (0.05 micron), the production of complex structures, and savings, are demonstrated in applications such as rocket combustion chambers with integrated cooling channels, spherical absorbers for solar-energy facilities, cooled gratings for nuclear-fusion experiments, reflectors, and high-frequency components. The efficiency of auxiliary electrodes in maintaining even deposition on angular concave mold surfaces is shown. T.K.

A83-33987#

THERMAL ENERGY STORAGE DEVELOPMENT FOR SOLAR ELECTRICAL POWER AND PROCESS HEAT APPLICATIONS

L. G. RADOSEVICH (Sandia National Laboratory, Livermore, CA) and C. E. WYMAN (Solar Energy Research Institute, Golden, CO) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 111-118. refs (Contract EB-02-01; EG-77-C-01-4042)

Development of thermal energy storage technologies for solar thermal systems has been conducted since the mid-1970s. This paper presents an overview of past and present experimental activities for electrical power and process heat applications both within and outside the United States. The factors affecting the selection of a storage technology for these applications, as well as the nature of those applications, are discussed. Future research needs are also described. Author

A83-33989#

PERFORMANCE BENEFITS OF THE DIRECT GENERATION OF STEAM IN LINE-FOCUS SOLAR COLLECTORS

E. K. MAY and L. M. MURPHY (Solar Energy Research Institute, Golden, CO) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 126-133. Research supported by the U.S. Department of Energy. refs

The performance benefits of the direct (in situ) generation of steam in the receiver tube of a line-focus solar collector are assessed in this paper. Compared to existing technology using steam-flash or unfired boiler systems, the in situ technique could reduce the delivered cost of steam in excess of 25 percent. The analysis indicates that two-phase flow instabilities, if present, can be readily controlled, and that the possibility of freezing is not an impediment to the use of water in cold climates. Author

A83-33990#

EXERGY ANALYSIS FOR THE PERFORMANCE OF SOLAR COLLECTORS

M. FUJIWARA (Ministry of International Trade and Industry, Electrotechnical Laboratory, Ibaraki, Japan) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 163-167 refs

The optimum control and performance evaluation of solar collectors are analyzed from the standpoint of exergy. The pressure drop inside the collector is introduced to the analysis using the Hottel-Whillier model. By treating the friction process as exergy loss, the optimum operating conditions are presented in a simple statement. The maximum capability of collectors is determined and expressed by a relationship among the collector parameters and the environment in which they operate. Author

A83-33991#

CORRELATIONS OF SOLAR INSOLATION AND WIND DATA FOR SOLMET STATIONS

D. E. RANDALL and N. R. GRANDJEAN (Sandia National Laboratory, Albuquerque, NM) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 168-173.

(Contract DE-AC04-76DO-00789)

Correlations of direct solar insolation and windspeed data based upon a 12.5-year period are presented for 26 SOLMET stations distributed over the contiguous United States. These correlations indicate that for all 26 stations 97.5 percent of the available direct insolation occurs at windspeeds of 15 m/s (33.6 mph) or less for three different solar collector tracking apertures. These results imply that operational wind load design criteria for tracking collector devices may be less stringent than is required for survival criteria in the stow orientation. Additional selected frequency distributions for direct insolation, windspeed, and wind direction data spanning the 1952-1964 time frame are also presented. Author

A83-33993#

TEMPERATURE CONTROL OF LINE-FOCUS SOLAR COLLECTORS

J. D. WRIGHT (Solar Energy Research Institute, Golden, CO) and M. MASTERSON (Masterston and Co., Worcester, MA) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 194-199. refs

Solar thermal electric power and industrial process heat systems may require a constant outlet temperature from the collector. This temperature may be efficiently maintained by adjusting the circulating fluid flow rate. Using frequency response techniques, simple relations are developed which relate controller tuning constants to collector construction and field layout. Successful controller tuning is shown to be a compromise between good response at high flow rates and stability at low flow rates. The rules of thumb are then tested by performing dynamic numerical simulations of a collector row with flow rate control. Author

A83-34068

SOLAR FLUX DISTRIBUTIONS FROM CIRCULAR CYLINDRICAL CONCENTRATORS

J. K. SHARMA, A. DANG, H. P. GARG, and S. S. MATHUR (Indian Institute of Technology, New Delhi, India) Solar Energy (ISSN 0038-092X), vol. 30, no. 6, 1983, p. 507-512 refs

Solar flux distributions produced by circular cylindrical concentrators have been determined. An integral relationship for evaluating the energy density distribution on receivers of arbitrary shape has been developed. The solar intensity distributions have been calculated for flat and cylindrical receivers. The developed formulae are applied to uniform and nonuniform source intensity distributions. The effect of longitudinal defocussing on the intensity distributions on receivers has also been considered. In case of cylindrical receivers, the local concentration decreases with an increase in the radius of receiver as well as with the rim angle of the receiver. Author

A83-34069

SOLAR GASIFICATION OF CARBONACEOUS MATERIALS

R. W. TAYLOR (California, University, Livermore, CA), R. BERJOAN, and J. P. COUTURES (CNRS, Laboratoire des Ultra-Refractaires, Odeillo, Pyrenees-Orientales, France) Solar Energy (ISSN 0038-092X), vol. 30, no. 6, 1983, p. 513-525 refs

Charcoal, wood and paper have been gasified in a packed-bed reactor using steam and solar energy. The steam was generated by spraying water directly on to the surface of the fuel and, at the same time, heating the fuel at the focus of a solar furnace. Half of the steam reacted with carbon and 30 pct of the incident solar energy was stored as chemical enthalpy. The performance of a fluidized-bed reactor was compared to that of a packed-bed reactor using charcoal and CO₂. The fraction of the incident solar energy utilized to produce CO (stored) was 10 pct in the case of the fluidized-bed reactor and 40 pct for the packed-bed reactor. The fuel value of the gas produced from the steam-gasification of wood and paper was 65 kcal/mole (320 Btu/lb). On an ash free basis the volume yield of the gas was within 0.1 of 1 cu m/kg. Author

A83-34071

FEASIBILITY STUDY ON THE ETHANOL-WATER SOLAR FRACTIONATING SYSTEM

J. M. SCHREYER (Oak Ridge National Laboratory, Oak Ridge, TN), J. J. PERONA (Tennessee, University, Knoxville, TN), and J. W. WILLIAMS Solar Energy (ISSN 0038-092X), vol. 30, no. 6, 1983, p. 545-553. refs

(Contract W-7405-ENG-26)

In order to demonstrate the feasibility of vacuum distillation of alcohol by using flat-plate collectors to provide the energy, an experimental solar still was designed, constructed and tested. The complete system provided for water heating and storage and the fractionation of ethanol-water mixtures in the alcohol still. The results of our experiment confirm that such a system is technically practical for the production of better than 90 percent ethanol. Author

A83-34074

STATIONARY NONIMAGING CONCENTRATOR AS A SECOND STAGE ELEMENT IN TRACKING SYSTEMS

E. M. KRITCHMAN, K. A. SNAIL, J. OGALLAGHER, and R. WINSTON (Chicago, University, Chicago, IL) Solar Energy (ISSN 0038-092X), vol. 30, no. 6, 1983, p. 601, 602 refs

An increase in the concentration in line focus solar concentrators is shown to be available using an evacuated compound parabolic concentrator (CPC) tube as a second stage element. The absorber is integrated into an evacuated tube with a transparent upper section and a reflective lower section, with a selective coating on the absorber surface. The overall concentration is calculated in consideration of a parabolic mirror in a trough configuration, a flat Fresnel lens over the top, or a coma corrected Fresnel lens. The resulting apparatus is noted to also suppress thermal losses due to conduction, convection, and IR radiation. M.S.K.

A83-34150

ENGINEERING DESIGN FOR A CENTRAL STATION PHOTOVOLTAIC POWER PLANT

E. J. SIMBURGER and R. B. FLING (Aerospace Corp., Los Angeles, CA) (Institute of Electrical and Electronics Engineers, Summer Meeting, San Francisco, CA, July 18-23, 1982) IEEE Transactions on Power Apparatus and Systems (ISSN 0018-9510), vol. PAS-102, June 1983, p. 1668-1677. refs

The engineering design effort presented in this paper is an attempt to bring the various components and subsystems that would be required in a Central Station Photovoltaic Power Plant together in the form of a complete preliminary engineering design for the plant. The design identifies all of the subsystems and defines the interfaces required for integrating each subsystem into the total plant system. The resultant preliminary engineering design can be used for further subsystem optimization and tradeoff studies. Author

A83-34374

ALTERNATIVE ENERGY SOURCES IV; PROCEEDINGS OF THE FOURTH MIAMI INTERNATIONAL CONFERENCE, MIAMI BEACH, FL, DECEMBER 14-16, 1981. VOLUME 1 - SOLAR COLLECTORS STORAGE

T. N. VEZIROGLU, ED. (Miami, University, Coral Gables, FL) Conference sponsored by the U.S. Defense Advanced Research Projects Agency Ann Arbor, MI, Ann Arbor Science Publishers, 1982, 447 p

Aspects of solar measurements, solar collectors, selective coatings, thermal storage, phase change storage, and heat exchangers are discussed. The analysis and testing of flat-plate solar collectors are addressed. The development and uses of plastic collectors, a solar water heating system, solar energy collecting oil barrels, a glass collector panel, and a two-phase thermosyphon system are considered. Studies of stratification in thermal storage, of packed bed and fluidized bed systems, and of thermal storage in solar towers, in wall passive systems, and in reversible chemical reactions are reported. Phase change storage by direct contact processes and in residential solar space heating and cooling is examined, as are new materials and surface characteristics for solar heat storage. The use of R-11 and Freon-113 in heat exchange is discussed. No individual items are abstracted in this volume. C D

A83-34406

MEASUREMENTS OF THE DISTRIBUTION OF THE FLUX OF ENERGY IN THE FOCUS OF A SOLAR CONCENTRATOR WITH VISUALIZATION TECHNIQUES

P. OTTONELLO and G. A. ROTTIGNI (Genova, Università, Genova, Italy) Nuovo Cimento C, Geophysics and Space Physics, vol. 5C, Sept.-Oct. 1982, p. 515-527. refs

The construction of an optical head which allows a section of the flux distribution of energy along the focal axis of optical systems in general and of solar concentrators in particular to be visualized is described. A circular solar concentrator whose reflector consists of a plastic lamina aspirated by means of a pump has been built. The concentrator's characteristic elements and operation are shown, and the measurement of the concavity of the reflecting lamina is discussed. The distribution of the energy flux in the focus of the concentrator is calculated using computer techniques, obtaining the characteristics of the energy distribution trend as functions of the length along the focal axis, the trend of minimum relative dispersions as a function of the focal distance, and the maximum values of the relative amplitude and the loss function with respect to distance along the focal axis. C.D

A83-34409

A DYNAMIC SIMULATION OF A FLAT-PLATE COLLECTOR SYSTEM

A. ANNINO (Catania, Università, Catania, Italy) Nuovo Cimento B, Serie 11, vol. 74 B, April 11, 1983, p. 139-150. Research supported by the Comitato Regionale Ricerche Nucleari e Struttura della Materia and Ministero della Pubblica Istruzione. refs

A numerical model for the performance of a flat plate solar collector array is presented, with account taken of thermal transients and calculation on a microcomputer. The system modeled consists of a flat plate array, the heat transfer fluid, an insulated storage tank, an exchange loop for heating a secondary fluid, and a load maintained by a pump. The one-dimensional analysis includes equations for the energy balances, with consideration given to heat losses to the outside. A function is defined for the total incident solar radiation, and behavior is simulated over the entire 24-hr day, weighted by the highest and lowest recorded temperatures. Good agreement has been found with experimental data. M.S.K.

A83-34515

DETERMINATION OF MINORITY CARRIER LIFETIME AND EFFECTIVE BACK SURFACE RECOMBINATION VELOCITY IN BSF SILICON SOLAR CELLS FROM TRANSIENT MEASUREMENTS

S. C. JAIN, S. K. AGARWAL, and U. C. RAY (Solid State Physics Laboratory, Delhi, India) Electronics Letters (ISSN 0013-5194), vol. 19, May 12, 1983, p. 365-367. refs

A83-34525

PROPOSING A NEW BACKWARD SOLAR CELL

K. K. GOVIL Electronics Letters (ISSN 0013-5194), vol. 19, May 12, 1983, p. 395-397. refs

The theory and performance of a solar cell manufactured as a backward diode are explored numerically and consideration is given to candidate materials. Reducing the doping in a tunnel diode results in a peak current that near or slightly greater than the valley current, thus forming the backward diode. The current flow direction is then in the third quadrant, and the Fermi level is close to the valence band edge on the p-side and the conduction band edge on the n-side. The contact potential is nearly equal to the bandgap of the semiconductor. Calculations of the I-V characteristics of the backward solar cell are presented, together with a formulation for the maximum power point. Use of a direct-gap semiconductor such as GaAs is recommended, with the caveat that strict quality control is required to control the doping levels. M.S.K.

A83-34657#

THE SOLAR POWER SATELLITE - AN OVERVIEW

P. FOLDES (General Electric Co., Space Systems Div., Philadelphia, PA) IN: Earth-oriented space activities and their legal implications, Proceedings of the Symposium, Montreal, Canada, October 15, 16, 1981. Montreal, McGill University, 1983, p. 123-166. refs

The design, technical challenges, environmental concerns, and costs of a solar power satellite (SPS) for beaming energy to a receiver on earth are discussed. Elements of the SPS include the spacecraft, i.e., the collector and microwave beam generator, the rectenna receiver, the launch system, and the control system. An approximately 10 x 5 km solar cell array in GEO would convert solar energy to dc electricity, channel it to a microwave conversion device, which directs the beam to an approximately 69 sq km rectenna on earth, where the microwaves are converted to dc power and then to 4 GW of utility quality ac electricity. Klystrons could be used for the conversion of dc to microwave on the SPS, while the dc SPS power could alternatively be generated by Brayton cycle engines. An entirely new STS would have to be built to place the SPS in orbit, for a cost of about \$18 billion for the whole launch system and construction, with a final cost of 6-13 cents/kW installed. M.S.K.

02 SOLAR ENERGY

A83-34658#

SOLAR POWER SATELLITES - TECHNICAL, SOCIAL AND POLITICAL IMPLICATIONS

F H KNELMAN (Concordia University, Montreal, Canada) IN Earth-oriented space activities and their legal implications; Proceedings of the Symposium, Montreal, Canada, October 15, 16, 1981. Montreal, McGill University, 1983, p. 167-203 refs

Solar power satellite systems (SPS) are examined, together with their environmental and social impacts and the energy policies necessary for their construction. The energy source, the sun, is acceptable to advocates of decentralized technologies, while the conversion system is fitted to large institutions. However, large-scale power plants are subject to persistent malfunctions, and the approximately 50 sq km SPS solar array is projected to suffer from at least recurring cell contact failures. The power could also be generated by heat engines for transmission by either laser or microwaves. Numerous feasibility and cost-benefit studies are still required, including defining the transmission beam's effects on the atmosphere, ionosphere, and human health. Furthermore, the resource allocations, capital costs, insurance, and institutional problems still need clarification, as do the design, logistics, and development of an entire new, much larger launch system based on Shuttle technology. Finally, the military defensibility of the SPS power station is questioned. M.S.K

A83-34666

STATIC CONCENTRATORS THEORY FOR NON-HOMOGENEOUS EXTENDED SOURCES

J. C. MINANO and A. LUQUE (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) Solar Cells (ISSN 0379-6787), vol. 8, May 1983, p. 297-315. refs

It is shown analytically that the sun is not a homogeneous radiation source from the point of view of concentrating solar collectors, and a procedure is presented for calculating the actual radiance of the source. The actual annual solar irradiance is modeled as the sum of radiances of the whole sky when the sun is in particular positions in the sky during the year. Both direct and diffuse radiation are accounted for. The total is related to the power flux received at the entry aperture of a concentrator when the sun is at each position over the year. The inhomogeneous power flux is then converted into a homogeneous flux by treating the source as a set of slices, where each slice is a homogeneous source of radiance. The power flux is calculated for a compound parabolic concentrator with bifacial solar cells, with consideration for parameters such as the different semiacceptance angles and the angle of elevation over the equatorial plane. An example is worked out for Madrid, and the model developed is concluded to yield values that are accurate to within 5-10 percent. M.S.K.

A83-34667

VARIABLE MINORITY CARRIER TRANSPORT MODEL FOR AMORPHOUS SILICON SOLAR CELLS

H. OKAMOTO, H. KIDA, S. NONOMURA, and Y. HAMAKAWA (Osaka University, Toyonaka, Japan) Solar Cells (ISSN 0379-6787), vol. 8, May 1983, p. 317-336 refs

A variable minority carrier transport model for optimizing photovoltaic properties unique to a-Si solar cells is presented. Computations showed that the carrier recombination rate is governed by the lifetime and excess density of the minority carriers. Analytical formulations were developed for the carrier collection efficiency spectra and the dark and illuminated current density-voltage characteristics, expressed in terms of the mobility lifetime products, effective surface recombination factors, and conductivities at the p-i and i-n interfaces. The intrinsic material (i) was modeled as having two regions at a variable boundary, with electrons or holes in each region behaving like minority carriers and governing the recombination rate. Enhanced cell performance was found to be available from, e.g., a large built-in voltage, from large values of the sum of the hole-mobility and electron-mobility products, and for a large disparity in the hole-mobility and electron mobility products. M.S.K

A83-34668

IMPORTANCE OF THE EMITTER IN THIN BACK-SURFACE FIELD SOLAR CELLS

S. K. MEHTA and S. C. JAIN (Solid-State Physics Laboratory, Delhi, India) Solar Cells (ISSN 0379-6787), vol. 8, May 1983, p. 337-353 refs

The results of an analytical study of variations in the open-circuit voltage and the efficiency of a back-surface field (BSF) solar cell under AM0, one sun illumination conditions are presented. Account was taken of the variations in the short-circuits current, the base dark saturation current density, and the effects on the performance parameters with different values of the base thickness. Computations were performed to characterize the variation in the effective surface recombination velocity at the edge of the low-high junction without band gap narrowing in the high region when different recombination velocities were used at the back contact. Finally, the temperature degradation coefficient of the open-circuit voltage was formulated, with consideration given to band gap narrowing in the emitter and the high region. Decreases in the base thickness were shown to increase the importance of the emitter dark saturation current for determination of the open-circuit voltage. M.S.K

A83-34669

LUMINESCENT SOLAR CONCENTRATORS AS BIFACIAL CAPTORS

G. LIFANTE, F. CUSSO, F. MESEGUER, and F. JAQUE (Consejo Superior de Investigaciones Cientificas, Instituto de Fisica del Estado Solido, Madrid, Spain) Solar Cells (ISSN 0379-6787), vol. 8, May 1983, p. 355-360. Research supported by the Comision Asesora de Investigacion and Ministry of Industry refs

The results of trials with bifacial luminescent solar concentrators (LSCs) in attempts to increase the collection efficiencies are reported. The LSCs function by using a transparent flat plate containing solar energy-absorbant luminescent chemicals that pipe the absorbed energy to the edge, where solar cells can be irradiated. The experiments consisted of polymethylmethacrylate films impregnated with a luminescent dye. Monocrystalline solar cells were attached at one edge and the other edges were blackened. Rhodamine B, coumarin, and fluoro dyes were used in separate sheets, and were found to bring the absorption to about 90 percent. The sheets were placed at a 40 deg angle on a diffusing surface and measurements were made of the short circuit current and the current with and without the diffusing surface being covered. Efficiency gains of up to 80 percent were obtained, and were independent of the solar time or sky conditions. M.S.K

A83-34671

MODEL CALCULATIONS FOR SILICON INVERSION LAYER SOLAR CELLS

W. A. MILLER and L. C. OLSEN (Joint Center for Graduate Study, Richland, WA) Solar Cells (ISSN 0379-6787), vol. 8, May 1983, p. 371-395 refs

A theoretical treatment of Si-based inversion-layer (IL) solar cells is presented. IL solar cells consist of a p-type semiconducting substrate with a back contact, a metal grid with a rectifying junction beneath the grid area, and a transparent insulating layer on the front surface containing a fixed charge which functions as an AR coating. The fixed charge creates the IL, i.e., the induced surface junction, in the area between the grid lines. The use of MIS contacts has thus far produced cells with efficiencies up to 15 pct, although calculations show that cells of 19 percent efficiency are possible, with processing temperatures of less than 500 C. The failure to reach the optimized efficiencies has been attributed to high sheet resistances in the IL, and calculations were performed to quantify the resistance as a function of the cell parameters and relate them to the device performance. The formulation of a two-dimensional model led to the conclusion that high efficiency is obtainable with a wide range of insulator charge densities, while the grid line spacing must remain a factor of two or three times that of conventional diffused cells. M.S.K.

A83-34674

SOLAR OPERATED WATER-AMMONIA ABSORPTION HEAT PUMP FOR AIR-CONDITIONING - MODELLING AND SIMULATION

E. BROUSSE, B. CLAUDEL, and J. P. MARTINE (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhone, France) Applied Energy (ISSN 0306-2619), vol. 14, no. 2, 1983, p. 131-142 refs

A83-34675

HEAT LOSS OPTIMISATION OF A CONCENTRIC CYLINDRICAL SOLAR COLLECTOR EMPLOYING A COBALT OXIDE SELECTIVE ABSORBER

C. CHOUDHURY, N. K. BANSAL, and H. K. SEHGAL (Indian Institute of Technology, New Delhi, India) Applied Energy (ISSN 0306-2619), vol. 14, no. 2, 1983, p. 143-159 refs

A83-35404#

SOLAR POWER SATELLITES AND TELECOMMUNICATIONS

W. E. GORDON (Rice University, Houston, TX) and L. M. DUNCAN (Los Alamos National Laboratory, Los Alamos, NM) Radio Science (ISSN 0048-6604), vol. 18, May-June 1983, p. 291-298 refs

The problems considered are those that will arise at least two decades hence. The SPS reference system defined by the Department of Energy (DOE) and NASA is described. According to this system, a total of 300 GW would be available in 30 years if two satellites and receiving antennas were deployed each year. In discussing the biological aspect, it is noted that problems in human exposure will have to be resolved in a situation where national standards can vary by a factor of 1000. Other problems are interference of the SPS microwave radiation with other systems, the effect of the microwave beam on radio propagation mechanisms, and the possible crowding of the geosynchronous orbit. C.R.

A83-35437

MEASUREMENT OF BORON DIFFUSIVITY IN HYDROGENATED AMORPHOUS SILICON BY USING NUCLEAR REACTION B-10(N, ALPHA)Li-7

H. MATSUMURA, K. SAKAI, M. MAEDA, S. FURUKAWA (Tokyo Institute of Technology, Yokohama, Japan), and K. HORIUCHI (Musashi Institute of Technology, Kawasaki, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 54, June 1983, p. 3106-3110. refs

The method of measuring the boron profile in silicon by the nuclear reaction B-10(n, alpha)Li-7 is studied and its validity for estimating the diffusivity of B is checked. The B diffusivity in glow-discharged hydrogenated amorphous silicon (a-Si:H) is evaluated for various temperatures by observing the change of B profiles after annealing. It is found that the diffusivity of B in a-Si:H is much larger than that in crystalline Si, and that the activation energy of B diffusivity is about 1.5 eV. The diffusivity of B and its activation energy are nearly equal to those of hydrogen in a-Si:H. Finally, the minimum duration in which the characteristics of a-Si:H solar cells having thin B-doped p layers may start to change due to this B diffusion is predicted to be about several tens of years when they operate at 100°C. C.D.

A83-35442

MOBILITY-LIFETIME PRODUCT AND INTERFACE PROPERTY IN AMORPHOUS SILICON SOLAR CELLS

H. OKAMOTO, H. KIDA, S. NONOMURA, K. FUKUMOTO, and Y. HAMAKAWA (Osaka University, Toyonaka, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 54, June 1983, p. 3236-3243. Research supported by the Ministry of Education and Agency of Industrial Science and Technology refs

A technique for evaluating the mobility-lifetime product of electrons and holes for amorphous Si solar cells is reported and used to assay the variation of the products with impurity doping, temperature, and prolonged light exposure. The product was examined as a significant indicator of solar cell performance and durability. The a-Si:H cells examined were prepared by an rf technique, and the spectral response of the photocurrent was

examined in monochromatic light. The maximum products were observed when small amounts of boron atoms were used as the dopant. The hole lifetime dominated the photoconductivity in undoped and phosphorus doped cells, while the electron lifetime was dominant in boron doped cells. The mobility-lifetime product controlled the effective surface recombination factor. The method was concluded useful for optimizing the material, structure, and manufacturing processes for producing higher performance, reproducible, and stable a-Si:H pin solar cells. M.S.K.

A83-35451

CUPROUS OXIDE-INDIUM-TIN OXIDE THIN FILM PHOTOVOLTAIC CELLS

M. FUJINAKA (Tokyo Denki University, Tokyo, Japan) and A. A. BEREZIN (McMaster University, Hamilton, Ontario, Canada) Journal of Applied Physics (ISSN 0021-8979), vol. 54, June 1983, p. 3582-3588. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

Variations of the performance characteristics of Cu₂O films sputter-deposited on different compositions of ITO films on glass to form solar cells were examined experimentally. The RF sputtered ITO films were studied for electrical resistance, the Auger signal, and the optical transmittance. Cu₂O films were investigated in terms of the effectiveness of varying the manufacturing processes, with the critical parameters being the electrical conductivity, the thermostimulated conductivity, and the I-V characteristics. A fabrication process of 20 cu cm/min and 100 cu cm/min was selected for O₂ and Ar, respectively, during the sputtering. Solar cell output measurements were confined to ITO films with an Sn concentration higher than the In concentration. The presence of either a small diffusion length or interface recombination centers limited the overall efficiencies to about 1 percent. Further optimization studies are recommended due to the possibility of low-cost mass production of the cells. M.S.K.

A83-35457

SELECTIVE SURFACES OF ANODIC COPPER OXIDE FOR SOLAR COLLECTORS

A. A. MILGRAM (Weizmann Institute of Science, Rehovot, Israel) Journal of Applied Physics (ISSN 0021-8979), vol. 54, June 1983, p. 3640-3642 refs

A83-35986

THE GROWTH AND CHARACTERIZATION OF EPITAXIAL SOLAR CELLS ON RESOLIDIFIED METALLURGICAL-GRADE SILICON

R. V. DAIELLO, P. H. ROBINSON, and E. A. MILLER (RCA Laboratories, Princeton, NJ) RCA Review (ISSN 0033-6831), vol. 44, March 1983, p. 30-47. Research supported by the U.S. Department of Energy refs

This paper describes the results obtained at RCA Laboratories in the development of a solar-cell process based on using epitaxial thin films grown on a substrate made from low-cost metallurgical-grade (MG) silicon. The properties of the starting MG feedstock are described and related to the observed problem of SiC particle formation during ingot solidification. Data obtained on the size, spatial distribution in ingots, and the subsequent effect of particles on epitaxial solar-cell performance are presented. Methods for significantly reducing the SiC particle density were developed and are discussed along with the characteristics of solar cells made in particle-free material. The rotary-disk reactor used for epitaxial growth of solar-cell structures and its scale-up to large area and high throughput is described. Author

A83-36000

SILICON CARBIDE (SiSiC), A NEW MATERIAL FOR APPARATUS CONSTRUCTION [SILIZIUMCARBID /SiSiC/, EIN NEUER WERKSTOFF FUER DEN APPARATEBAU]

G. WILLMANN (Didier-Werke AG, Wiesbaden, West Germany) and W. HEIDER (Sign Elektrographit GmbH, Meitengen, West Germany) Zeitschrift fuer Werkstofftechnik (ISSN 0049-8688), vol. 14, April 1983, p. 135-140. In German. refs

During the last few years, ceramic materials have been increasingly taken into consideration in connection with applications related to the construction of machines and apparatus. The present investigation is concerned with the status of development and technology of relatively large ceramic structural components consisting of reaction sintered, free silicon-containing silicon carbide (SiSiC), taking into account the employment of such components for the construction of apparatus. In particular, applications related to the design of a solar tower power station are investigated. In the case of the considered power station, a set of mirrors is employed to concentrate sunlight on two solar receiver modules which are located on the peak of a 200-m tower. An optimum system efficiency can be achieved for conditions involving gas exit temperatures of about 1000 C. Metallic materials cannot be used under these conditions, and materials, such as the SiSiC, are needed. G. R.

A83-36011

POLYCRYSTALLINE SILICON SHEETS FOR SOLAR CELLS BY IMPROVED SPINNING METHOD

Y. MAEDA, T. YOKOYAMA, and I. HIDE (Hoxan Corp., Hoxan Research Laboratories, Sapporo, Japan) Electronics Letters (ISSN 0013-5194), vol. 19, June 9, 1983, p. 441, 442.

Large-grain polycrystalline silicon sheets for solar cells 50 mm square and 0.1 to 0.5 mm thick, have been obtained directly by spinning the silicon melt and diffusing it into mold cavities. Production time from melt is about four sheets per 15 s. Using this sheet, 9 to 10 percent AM 1.5 solar-cell efficiencies were achieved. Author

A83-36594

THERMAL PERFORMANCE OF RADIATIVE COOLING PANELS

P. BERDAHL, M. MARTIN, and F. SAKKAL (California, University, Berkeley, CA) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 26, June 1983, p. 871-880 refs (Contract DE-AC03-76SF-00098)

The performance of panels which cool by means of thermal infrared heat transfer to the sky is calculated from basic principles. The efficiency of a radiative cooling panel is defined. Computer calculations with the full heat transfer equations are performed for horizontal surfaces with infrared-transparent covers. Plots of efficiency versus a dimensionless temperature difference are shown to be insensitive to variations in air temperature, wind speed, and sky radiance, resulting in plots analogous to standard efficiency curves for solar panels. Experimental measurements show that, for most applications, white paint is a better radiator than aluminized polyvinyl fluoride film. Author

A83-36736

ACCELERATED TEMPERATURE AGING OF BLACK CHROME SOLAR SELECTIVE COATINGS

R. B. PETTIT (Sandia National Laboratory, Albuquerque, NM) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 349-361. refs (Contract DE-AC04-76DP-00789)

An accelerated aging study was performed on four electrodeposited black chrome solar absorber surfaces prepared in different plating baths. All the samples were deposited on Ni foil substrates and were exposed to aging temperatures of 350, 375, 400, 425, and 450 C in furnaces. Solar absorptance was measured at various times during the aging, which was carried out for 10,000 hr. All the samples exhibited a gradual decrease in absorptivity properties over time, with increasing temperature during aging causing a faster rate of absorptivity loss. However, samples in a 300 C furnace displayed an initial 25-30 pct loss, and longer

term additional 7-16 pct losses. Arrhenius behavior, concluded by the logarithm of the shift factors as a function of the reciprocal of the temperature, indicated oxidation of the chrome component of the surface was the degradation process. Thermal aging acceptance tests at 450 C are indicated for quickly exposing the long-term thermal stability of the coatings. M. S. K.

A83-36737

PREPARATION AND PROPERTIES OF Si/SnO₂ HETEROJUNCTIONS

W. BADAWY (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften, Berlin, West Germany; Cairo, University, Cairo, Egypt), F. DECKER (Max-Planck-Institut zur Foerderung der Wissenschaften, Berlin, West Germany, Campinas, Universidade, Estadual, Campinas, Sao Paulo, Brazil), and K. DOBLHOEFER (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften, Berlin, West Germany) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 363-369 refs

A combined spray-CVD method is discussed by which SnO₂ films can be prepared reproducibly using the high-temperature hydrolysis reaction of SnCl₄. Homogeneous films of good conductivity were obtained when the reaction mixture SnCl₄/H₂O contained only 50 percent or less of the stoichiometric amount of water. Heterojunctions were produced by depositing the films on Si single crystals. For these devices the dependence of the photocurrent-voltage curve on the conductivity of the SnO₂ was analyzed. Author

A83-36738

TRANSPARENT HEAT-REFLECTING COATINGS FOR SOLAR APPLICATIONS BASED ON HIGHLY DOPED TIN OXIDE AND INDIUM OXIDE

G. FRANK, E. KAUER, H. KOESTLIN (Philips GmbH, Forschungslaboratorium, Aachen, West Germany), and F. J. SCHMITTE (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 387-398 refs

A83-36739

TRANSPARENT HIGH SURFACE AREA POROUS SUPPORTS AS NEW MATERIALS FOR LUMINESCENT SOLAR CONCENTRATORS

R. REISFELD, N. MANOR, and D. AVNIR (Jerusalem, Hebrew University, Jerusalem, Israel) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 399-409. Research supported by the Israel Ministry of Energy. refs (Contract DOE-80-1-09)

A83-36741

ELECTROCHEMICAL MEASUREMENTS ON THE PHOTOELECTROCHEMICAL REDUCTION OF AQUEOUS CARBON DIOXIDE ON P-GALLIUM PHOSPHIDE AND P-GALLIUM ARSENIDE SEMICONDUCTOR ELECTRODES

B. AURIAN-BLAJENI, M. HALMANN, and J. MANASSEN (Weizmann Institute of Science, Rehovot, Israel) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 425-440. Research supported by the United States-Israel Binational Science Foundation. refs

A83-36742

EFFECT OF BORON DOPING AND ITS PROFILE ON CHARACTERISTICS OF P-I-N A-Si:H SOLAR CELLS

H. HARUKI, H. SAKAI, M. KAMIYAMA, and Y. UCHIDA (Fuji Electric Corporate Research and Development, Ltd., Yokosuka, Japan) Solar Energy Materials (ISSN 0165-1633), vol. 8, Mar.-Apr. 1983, p. 441-455. Research supported by the Agency of Industrial Science and Technology. refs

The results of investigations of the effects of the boron profile and doping density on the conversion efficiency of ITO/nip/ss, ITO/pin/ss, and glass/ITO/pin/metal solar cells are reported. The cells were formed in an RF glow discharge process, with controlled variations of the thickness of the a-Si:H layer, as well as the doping density of boron and phosphorus being effected on different

samples. Efficiency improvements were obtained in all the cells with boron doping in the i-layer with concentrations varying from 1 to 3×10 to the 17th atoms/cu cm. Conversion efficiencies around 7.5 pct were obtained. A simple analytical model was developed for the increased efficiency, with the photon mobility-lifetime product improving within cells with a window-side layer to i-layer structures with photogenerated holes which have the capability of drifting throughout the i-layer M.S.K

A83-36744

PHOTOVOLTAIC AND STRUCTURAL PROPERTIES OF CUINSE2/CDS SOLAR CELLS

R. R. ARYA, R. BEAULIEU, J. J. LOFERSKI (Brown University, Providence, RI), W. GIRIAT (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela), T. WARMINSKI, and M. KWIETNIAK Solar Energy Materials (ISSN 0165-1633), vol 8, Mar-Apr 1983, p 471-481. Research supported by the U.S. Department of Energy and NSF refs

The photovoltaic and structural properties of a $\text{CuInSe}_2/\text{CdS}$ solar cell with the CuInSe_2 component being a large grained polycrystalline material with a low resistivity polycrystalline CdS film evaporated over it were examined. Scanning electron microscopy and X ray analysis were carried out on the samples, with the study focusing on the SK alpha, CuK alpha, SeK alpha, and InL alpha(1) line intensities. The substrate was characterized as a large grained polycrystal, while the CdS layer was homogeneous and close to stoichiometric proportion. Under electron beam illumination, imperfections such as microcracks on the crystal surface were found to cause deterioration in the current. Surface etching with a bromine-methanol solution also reduced the open-circuit voltage and produced a nonstoichiometric finish. Dimensioning the devices to reduce the defect areas enhanced the photovoltaic properties of the cells M.S.K

A83-36774

HIGH PERFORMANCE HYDROGENATED AMORPHOUS SILICON SOLAR CELLS MADE AT A HIGH DEPOSITION RATE BY GLOW DISCHARGE OF DISILANE

Y. OHASHI, J. KENNE, M. KONAGAI, and K. TAKAHASHI (Tokyo Institute of Technology, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol 42, June 15, 1983, p 1028-1030. Research supported by the Agency of Industrial Science and Technology refs

The deposition rate, electronic and optical properties of hydrogenated amorphous silicon films prepared from RF glow discharge decomposition of disilane (Si_2H_6) diluted in helium have been measured. These films show excellent electrical and optical properties and, most importantly, a high deposition rate coupled with satisfactory solar cell application was realized for the first time. At a deposition rate of 11 A/s, 5.47 percent and 6.5 percent conversion efficiencies were obtained with a first trial of n-p type solar cells deposited on SnO_2/ITO glass and metal substrates, respectively. Author

A83-37050* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THERMAL BEHAVIOR OF LABORATORY MODELS OF HONEYCOMB-COVERED SOLAR PONDS

E. I. H. LIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Solar Engineering - 1983. New York, American Society of Mechanical Engineers, 1983, p 143-149. NASA-supported research

Laboratory experiments were conducted to provide insight into the technical feasibility of honeycomb-covered solar ponds. Cooling tests using honeycomb panels of various materials and geometries showed that a 5.7-cm-thick one-tier panel insulated as effectively as a 10-cm fiberglass slab. Heating tests demonstrated that a model pond covered with a polycarbonate panel boiled upon 16 hours of continuous exposure to a 150-W spotlight. Analysis of the experimental data indicates positively that honeycomb-covered solar ponds can be expected to perform satisfactorily, and that larger-scale outdoor tests should be conducted to provide a more

realistic assessment and a more refined performance estimate

Author

A83-37055

ELECTRIC AND PHOTOELECTRIC PROPERTIES OF GRADED-BAND-GAP $\text{Ga}(1-x)\text{Al}(x)\text{As}$ P-N STRUCTURES [ELEKTRICHESKIE I FOTOELEKTRICHESKIE SVOISTVA VARIZONNYKH $\text{Ga}(1-x)\text{Al}(x)\text{As}$ P-N STRUKTUR]

K. ANNAEV, A. BERKELIEV, SH. MERETLIEV, and N. NAZAROV (Akademiia Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) Akademiia Nauk Turkmensoi SSR, Izvestia, Seria Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk (ISSN 0002-3507), no 1, 1983, p. 92-94. In Russian. refs

The fabrication of graded-band-gap n-GaAs-p-GaAs-p-Ga(1-x)Al(x)As structures is described, and experimental results on their electric and photoelectric properties are presented. It is shown that as the AlAs content in Ga(1-x)Al(x)As layers increases from 50 to 80 percent, the region of spectral photosensitivity is extended in the direction of short wavelengths. The photosensitivity of structures with an AlAs content of approximately 80 percent begins to fall at incident-photon energies greater than 2.4 eV. The photocurrent density-photovoltage characteristics show that the light-to-electric energy conversion efficiency attains a value of 16 percent in structures with an AlAs content of approximately 80 percent B.J

A83-37150

OPTIMAL CONTROL OF A BILINEAR SOLAR COLLECTOR/HEAT EXCHANGE SYSTEM

B. M. FRITCHMAN and W. J. GRANTHAM (Washington State University, Pullman, WA) IN: American Control Conference, 1st, Arlington, VA, June 14-16, 1982, Proceedings. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1982, p 1155-1157. refs

The problem of maximizing storage fluid temperature at a specified terminal time by controlling both collector and tank loop flow rates is investigated for a flat-plate solar water heating system containing a coupling counterflow heat exchanger. The dynamic system is modeled by two ordinary differential equations incorporating both collector plate and tank fluid capacitance. The paper considers the usual case where the tank loss-to-capacitance ratio is less than that of the collector plate. It is shown that the optimal control algorithm does not depend explicitly on the insolation. Furthermore, the optimal flow rates are shown to be on-off. However, if the collector loop pumping capacity is sufficiently greater than that of the tank loop, then the collector loop 'on' flowrate is not the maximum attainable flowrate. Author

A83-37790* Communications Satellite Corp., Clarksburg, Md.

LIMITATIONS ON SOLAR CELL OPEN-CIRCUIT VOLTAGE AND EFFICIENCY

A. MEULENBERG, JR and R. A. ARNDT (COMSAT Laboratories, Clarksburg, MD) COMSAT Technical Review, vol 13, Spring 1983, p 57-70. Research sponsored by the Communications Satellite Corp. refs (Contract NAS3-21227)

Techniques used to determine the open-circuit voltage of solar cells are analyzed. It is noted that the computational procedures for determining the output characteristics of a solar cell depend on a thorough understanding of the behavior of individual components. However, amorphous materials and combination solar cells exhibit increasingly complex behaviors and theoretical analyses therefore are continually more dependent on experimental data for verification. Formulations are defined for the base region and for diffusion length measurement. Experimental results are cited to show that, for low resistivity, planar surface cells, the dark current from the emitter is the dominant factor limiting increases in the Voc, which can be enhanced by improving the efficiency of the doping levels and profile to minimize the effects of bandgap narrowing, junction recombination current, and diffusion length of the emitter region M.S.K

A83-38015*# Jet Propulsion Lab, California Inst. of Tech, Pasadena

DISH CONCENTRATORS FOR SOLAR THERMAL ENERGY

L. D. JAFFE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Journal of Energy (ISSN 0146-0412), vol 7, July-Aug 1983, p 304-312 Research supported by the U.S. Department of Energy and NASA refs

Previously cited in issue 03, p. 397, Accession no A82-14001

A83-38018#

ECONOMIC FEASIBILITY OF RETROFIT SOLAR HOT WATER SYSTEMS

R. R. SOMERS, II, M. R. SEXTON (Virginia, University, Charlottesville, VA), A. C. PRITCHARD (Duke Power Co., Greenville, SC), M. C. HOFFMAN (Syska and Hennessy, Inc., Washington, DC), and L. S. FLETCHER (Texas A & M University, College Station, TX) (Solar engineering - 1981, Proceedings of the Third Annual Conference on Systems Simulation, Economic Analysis/Solar Heating and Cooling Operational Results, Reno, NV, April 27-May 1, 1981, p 431-438) Journal of Energy (ISSN 0146-0412), vol 7, July-Aug 1983, p 325-331 refs

Previously cited in issue 22, p 3517, Accession no A82-44335

A83-38019#

OPERATIONAL EXPERIENCE WITH FLAT-PLATE PHOTOVOLTAIC SYSTEMS

V. V. RISSER, P. HUTCHINSON, and S. DURAND (New Mexico Solar Energy Institute, Las Cruces, NM) Journal of Energy (ISSN 0146-0412), vol 7, July-Aug 1983, p 332-337.

In 1977-78 the U.S. Department of Energy initiated a program to obtain experience in the operation and maintenance of intermediate-sized photovoltaic systems. After evaluation of competitive proposals, four flat-plate and five concentrator-type photovoltaic systems were selected for construction. This paper describes the first-year operational results of two of the flat-plate systems, both located in the semiarid climate of the southwestern United States. The 20 kW system in El Paso, TX, has been operating since January 1981. The 100 kW system in Lovington, NM, has been operating since March 1981. A complete project record is maintained by using an extensive instrumentation system that records performance data and weather information at each site. This information is augmented by recording all required maintenance activity on the system. The New Mexico Solar Energy Institute is monitoring performance and assisting with maintenance on both systems. Performance to date is encouraging for those interested in this alternate energy technology. It clearly shows that successful operation of large-scale flat-plate systems is achievable today. Author

A83-38023*# Jet Propulsion Lab, California Inst of Tech, Pasadena.

SOLAR THERMAL TECHNOLOGIES - POTENTIAL BENEFITS TO U.S. UTILITIES AND INDUSTRY

K. L. TERASAWA and W. R. GATES (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug 1983, p 361-366 Research supported by the U.S. Department of Energy and NASA. refs

Solar energy systems were investigated which complement nuclear and coal technologies as a means of reducing the U.S. dependence on imported petroleum. Solar Thermal Energy Systems (STES) represents an important category of solar energy technologies. STES can be utilized in a broad range of applications servicing a variety of economic sectors, and they can be deployed in both near-term and long-term markets. The net present value of the energy cost savings attributable to electric utility and IPH applications of STES were estimated for a variety of future energy cost scenarios and levels of R&D success. This analysis indicated that the expected net benefits of developing an STES option are significantly greater than the expected costs of completing the required R&D. In addition, transportable fuels and chemical feedstocks represent a substantial future potential market for STES.

Due to the basic nature of this R&D activity, however, it is currently impossible to estimate the value of STES in these markets. Despite this fact, private investment in STES R&D is not anticipated due to the high level of uncertainty characterizing the expected payoffs. Previously announced in STAR as N83-10547 B.W.

A83-38213

THEORY OF ELECTRON-HOLE KINETICS IN AMORPHOUS SEMICONDUCTORS UNDER ILLUMINATION - APPLICATION TO SOLAR CELLS

R. E. LAGOS, T. TIEDJE (Exxon Research and Engineering Co., Linden, NJ), and H. SUHL (Exxon Research and Engineering Co., Linden, NJ, California, University, San Diego, CA) Journal of Applied Physics (ISSN 0021-8979), vol. 54, July 1983, p 3951-3957 refs

A general kinetic theory of the generation and recombination of electron-hole pairs for an illuminated amorphous semiconductor with an arbitrary distribution of gap states is presented. The basic assumptions of the theory are first, that sharp mobility edges separate localized states from extended states, and second that the localized states can communicate with each other only via the extended states. In the limit that mobile carriers are concentrated at the band edges, the coupled nonlinear integral equations for the occupation functions can be reduced to quadratures. The theory is applied to calculate the current-voltage characteristic of amorphous silicon solar cells, in the 'lumped circuit' model where the spatial dependence is neglected. The open circuit voltage, the fill factor and the upper limit for the solar conversion efficiency of such devices are calculated as functions of the gap density of states. Author

A83-38217

COMPARISON BETWEEN ELECTRON-BEAM AND FURNACE RAPID ISOTHERMAL ANNEALS OF PHOSPHORUS-IMPLANTED SOLAR CELLS

G. LULLI, P. G. MERLI, P. NEGRINI, P. OSTOJA, and S. SOLMI (CNR, Istituto LAMEL, Bologna, Italy) Journal of Applied Physics (ISSN 0021-8979), vol 54, July 1983, p 4127-4133 Sponsorship European Economic Community. refs (Contract EEC-ESC-R-041-I)

Solar cells have been fabricated using single crystal silicon wafers, implanted at 10-keV energy with 10 to the 15th P(+)/sq cm. Rapid isothermal heat treatments at temperatures ranging between 500 and 1000 C were used to anneal the implanted damage. Two different methods have been used: electron-beam and furnace annealing for times ranging between 0.5 and 5 min, and between 2 and 5 min, respectively. Characterization of P(+)-implanted layers and of completed solar cells allowed us to demonstrate that rapid isothermal anneals with furnace and electron beam give equivalent results. The efficiency of solar cells which are annealed using these rapid isothermal processes is fairly good (13.5 percent), even if slightly lower than that obtained with conventional anneals (750 C for 30 min). The reduced efficiency is a consequence of the lower value of the open circuit voltage. It is demonstrated that this effect is caused by residual defects in the space-charge region, produced by ion implantation. Author

A83-39461

WORKSHOP ON LIGHT-INDUCED CHANGE IN A-Si:H AND ITS EFFECT ON SOLAR CELL STABILITY, SAN DIEGO, CA, SEPTEMBER 24, 25, 1982

Y. HAMAKAWA, ED. (Osaka University, Toyonaka, Japan) and T. MCMAHON Workshop sponsored by the Solar Energy Research Institute. Solar Cells (ISSN 0379-6787), vol. 9, June-July 1983, 152 p.

Theoretical and experimental work on the development of amorphous hydrogenated Si solar cells is reported. Attention is focused on the mechanisms which lead to light-induced degradation of a-Si:H solar cell performance and to materials for amorphous Si solar cells. Performance degradation mechanisms such as a shift in the Fermi level near midgap and the increase in the gap state density in the lower half of the gap in pin cells are discussed. It is noted that the performance losses occur in the first 100 hr of

exposure to light and are removable by annealing. The theoretical models considered attribute the performance decrement to broken bonds, dangling bonds, or charge state or bond arrangement changes. Stable cells are suggested to be possible by minimizing the Staebler-Wronski effect in thin films by employing materials with collection widths larger than the intrinsic layer thickness necessary for efficient cell operation. M.S.K.

A83-39462

STABILITY OF P-I-N HYDROGENATED AMORPHOUS SILICON SOLAR CELLS TO LIGHT EXPOSURE

Y. UCHIDA, M. NISHIURA, H. SAKAI, and H. HARUKI (Fuji Electric Corporate Research and Development, Ltd., Nagasaka, Japan) (Solar Energy Research Institute, Workshop on Light-induced Change in a-Si:H and its Effect on Solar Cell Stability, San Diego, CA, Sept. 24, 25, 1982) Solar Cells (ISSN 0379-6787), vol. 9, June-July 1983, p. 3-12. Research supported by the Agency of Industrial Science and Technology refs

The results of measurements of the light-induced effect and forward current bias effect in a-Si:H solar cells are reported, together with high temperature and high humidity tests on encapsulated a-Si:H cells. The test samples consisted of ITO/pin/SS and ITO/nip/SS with various i-layer thicknesses, formed by glow discharge decomposition of SiH₄. The trials comprised continuous exposure to AM1 light, in addition to measurements of the effects of the application of a forward bias current density of 10 mA/sq cm in the dark for 4 hr. The i-layer thicknesses were varied from 0.35-0.6 micron. Thinner i-layers were found to correlate with fewer light-induced changes, with a greater thickness dependence exhibited by the nip configuration. Boron-doped pin cells were stable in light, indicating that appropriate junction structure and junction formation techniques can eliminate light-induced instability in the a-Si:H cell. Temperatures up to 100 C and 95 pct humidity with 60 C temperatures were tolerated by the encapsulated cells. M.S.K.

A83-39463

LIGHT-INDUCED EFFECTS IN INDIUM TIN OXIDE/N-I-P HYDROGENATED AMORPHOUS SILICON SOLAR CELLS

M.-K. HAN, W. A. ANDERSON (New York, State University, Amherst, NY), and H. WIESMANN (HT Products, Yonkers, NY) (Solar Energy Research Institute, Workshop on Light-induced Change in a-Si:H and its Effect on Solar Cell Stability, San Diego, CA, Sept. 24, 25, 1982) Solar Cells (ISSN 0379-6787), vol. 9, June-July 1983, p. 13-17 refs (Contract XS-9-8041-9)

Light-induced effects have been studied on hydrogenated amorphous silicon solar cells having an air mass 1 efficiency of 5-7 percent and an area of 0.1-0.2 sq cm. Within 72 h of illumination the open-circuit voltage did not decrease while the fill factor decreased from 0.6 to 0.4 and the short-circuit current density decreased from 11.5 to 10.5 mA/sq cm. The increased shunt current was found to be critical to the device performance of degraded cells. The increased shunt current may be due to an increased surface recombination velocity. The series resistance was almost unchanged. Annealing in air at 150 C restored much of the efficiency loss previously caused by light-induced effects. Author

A83-39465

LIGHT-INDUCED INSTABILITY OF AMORPHOUS SILICON PHOTOVOLTAIC CELLS

S. TSUDA, N. NAKAMURA, K. WATANABE, T. TAKAHAMA, H. NISHIWAKI, M. OHNISHI, and Y. KUWANO (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan) (Solar Energy Research Institute, Workshop on Light-induced Change in a-Si:H and its Effect on Solar Cell Stability, San Diego, CA, Sept. 24, 25, 1982) Solar Cells (ISSN 0379-6787), vol. 9, June-July 1983, p. 25-36. Research supported by the Agency of Industrial Science and Technology. refs

Changes in the characteristics of amorphous silicon (a-Si) solar cells caused by light exposure were studied. The degradation ratio of the conversion efficiency of p-i-n a-Si solar cells caused by

light exposure depends on the thickness of the i layer. A decrease in the fill factor was commonly observed, and in such cases the diode quality factor and shunt current density increased, which suggested a change in junction properties. It was shown that additional doping of the i layer with a small amount of boron prevents the decrease in conversion efficiency with light exposure. In a 1 year experiment on a 2 kW a-Si power generating system, a 10 percent decrease in conversion efficiency was observed (without additional boron doping) Author

A83-39466

EFFECTS OF OPTICAL STRESS ON THE PROPERTIES OF SPUTTERED AMORPHOUS SILICON SOLAR CELLS AND THIN FILMS

H. P. MARUSKA, T. D. MOUSTAKAS, and M. C. HICKS (Exxon Corporate Research Laboratory, Linden, NJ) (Solar Energy Research Institute, Workshop on Light-induced Change in a-Si:H and its Effect on Solar Cell Stability, San Diego, CA, Sept. 24, 25, 1982) Solar Cells (ISSN 0379-6787), vol. 9, June-July 1983, p. 37-51 refs (Contract XZ-0-9219)

Sputter deposited a-Si:H solar cells in an nip configuration were examined in AM1 conditions to quantify the long-term optical stress effects on the Schottky barrier devices. The rear contact was n-type PH₃-doped a-Si:H. The cells were assayed for spectral response, quantum efficiency, contact transmission, the short-circuit current density, and the current density-voltage (I-V) characteristics in the dark and in AM1 conditions. Test cells were exposed to either 200 or 400 hr of illumination to reach equilibrium and to detect any further changes in cell behavior. A total of 13 cells were tested, with four showing good stability. The spectral response peak of the cells shifted to the blue, which improved, indicating a decrease in the width of the depletion region. No correlation was found between the hydrogen content, target voltage, or substrate temperature and cell performance. M.S.K.

A83-39929

COLD PRESSED CADMIUM SELENIDE PHOTOANODES FOR ELECTROCHEMICAL SOLAR CELLS

A. MACKINTOSH, S. WESSEL, F. EL GUIBALY, and K. COLBOW (Simon Fraser University, Burnaby, British Columbia, Canada) Solar Energy Materials (ISSN 0165-1633), vol. 9, May-June 1983, p. 69-75. Research supported by the British Columbia Science Council and Natural Sciences and Engineering Research Council. refs

Cold pressing of cadmium selenide powder was investigated as a technique for producing photoanodes for electrochemical solar cells. Physical properties such as density, resistivity and surface morphology were determined and related to solar cell performance via wavelength response, quantum efficiency and white light current-voltage characteristics. The spectral response indicated a bandgap of 1.7 eV. Pellets pressed at higher pressure showed an improved quantum efficiency. Pressures above 69 MPa produced fractures in the pellets. Conversion efficiencies under white light (tungsten halide lamp) at 100 mW/sq cm were on the order of 1.5 percent. Author

A83-39930

SINGLE CRYSTAL CU₂S/CDS PHOTOVOLTAIC DEVICES WITH OPTIMUM PERFORMANCE BEFORE A POST BARRIER AIR BAKE

S. OKTIK, G. J. RUSSELL, and J. WOODS (Durham, University, Durham, England) Solar Energy Materials (ISSN 0165-1633), vol. 9, May-June 1983, p. 77-90. Research supported by the Turkish Ministry of National Education refs

Reflection electron diffraction and SEM have been employed in an investigation of the separate stages involved in the preparation of Cu₂S/CdS photovoltaic devices on single crystal substrates. Different etched surface types have been produced, for the formation of a topotaxial Cu₂S layer, which are found to be affected by the mechanical polishing of the hexagonal single crystal CdS that precedes etching. Devices made on surfaces with many ledges and kink sites on the sides of the etch hillocks have poor diode

characteristics and photovoltaic behavior in the as-made condition, while cells formed on surfaces with faceted hillocks have good rectifying and photovoltaic properties at this stage. Highest efficiencies are obtainable with as-plated cells, fabricated on surfaces that have been etched to produce hillocks having well-developed facets on substrates with optimum resistivity

O C

A83-39931

OPTICAL CONSTANTS OF AMORPHOUS HYDROGENATED CARBON AND SILICON-CARBON ALLOY FILMS AND THEIR APPLICATION IN HIGH TEMPERATURE SOLAR SELECTIVE SURFACES

D R MCKENZIE, N. SAVVIDES, D. R. MILLS, R. C MCPHEDRAN (Sydney, University, Sydney, Australia), and L C BOTTEN (New South Wales Institute of Technology, Broadway, Australia) Solar Energy Materials (ISSN 0165-1633), vol 9, May-June 1983, p. 113-126 Research supported by the New South Wales Institute of Technology and University of Sydney refs

A83-40337

NEW PROMISE FOR PHOTOVOLTAICS

R WHITAKER EPRI Journal (ISSN 0096-3941), vol 8, July-Aug. 1983, p 6-15.

The state-of-the-art of design and production of solar cells is examined, with emphasis on technologies that can lead to mass production of higher efficiency cells for utility-scale power plants. Research and development is concentrating on crystalline, polycrystalline, and thin film Si cells, and amorphous Si, GaAs, CdTe, and CuInSe₂ cells to broaden the spectral response. Concentrating systems can raise 8.5 percent efficient cells to 20 percent efficiency. Amorphous Si is amenable to the design of multijunction cells, with successive thin layers each responding to a different segment of the solar spectrum. A theoretical maximum efficiency of 23 percent is projected for the multijunction amorphous cells, while single ribbon Si cells offer 18 percent efficiency. Utility acceptance requirements are noted to include 15 percent efficiency from flat plate solar cell modules. It is suggested that solidly backed research funding can lead to significant contributions by solar cells to power generation in the 1990s

M.S.K

A83-40520

PERFORMANCE OF SOLAR ENERGY CONVERTERS: THERMAL COLLECTORS AND PHOTOVOLTAIC CELLS; LECTURES OF THE COURSE, ISPRA, ITALY, NOVEMBER 11-18, 1981

G. BEGHI, ED (Commission of the European Communities, Joint Research Centre, Ispra, Italy) Course sponsored by the Commission of the European Communities. Dordrecht, D. Reidel Publishing Co., 1983, 535 p.

The operational principles, performance results, and test and equipment designs for photovoltaic and solar flat plate collector systems are explored, with emphasis given to European programs. Attention is given to solar simulator and outdoor tests for collectors, and to indoor test calibration techniques and reliability testing procedure for photovoltaic cells and modules. The design and operation of the solar simulators at Ispra are described, together with the hybrid solar heating system for the facility and apparatus used for simulating corrosive atmospheres for testing collector panels. Simulation models being validated after development on the basis of data from previous test projects are presented, and current solar cell test programs in Europe are detailed. Finally, standardized solar cell and module and collector testing methodologies being implemented to qualify equipment to be tested in projects run by the Commission of the European Communities are reported.

M.S.K.

A83-40521

MEASUREMENT AND ANALYSIS OF SOLAR RADIATION DATA

F KESTEN (Meteorologisches Observatorium, Hamburg, West Germany) IN: Performance of solar energy converters Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 1-64 refs

The total solar radiation reaching the earth at the surface and the fringe of the atmosphere is considered in terms of its component wavelengths, temporal and global distribution, and the instrumentation available for measurements. The intensity of solar radiation peaks at 0.48 micron in near-earth space, while at the ground the peak is at 9.6 microns. The absorptances and albedoes in the longwave and shortwave portions of the spectrum are presented for various natural and artificial materials, and the contributions from direct and diffuse radiation are calculated in relation to the sky radiance. The temporal variation of the incoming radiation is numerically defined for the annual and hourly position of the earth and any location on it. Attention is also given to the total radiation impinging on an inclined surface on the earth. Finally, different types of pyranometers and pyrhemometers for assaying the solar radiation for solar energy conversion purposes are described.

M.S.K

A83-40522

SOLAR THERMAL COLLECTORS

E ARANOVITCH (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN: Performance of solar energy converters Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 65-102 refs

Thermal processes in solar flat plate collectors are described and evaluated analytically, and numerical models are presented for evaluating the performance of various designs. A flat plate collector consists of a black absorber plate which transfers absorbed heat to a fluid, a cover which limits thermal losses, and insulation to prevent backlosses. Calculated efficiencies for the collectors depend on the radiation absorbed, as well as IR losses due to natural convection, conduction, and radiation out of the collector. Formulations for the global emittance and heat transfer, as well as losses and their dependence on the Nusselt number and Grashof number are defined. Consideration is given to radiation transmission through transparent covers and Fresnel reflections at interfaces in the cover material. Finally, the performance coefficients for double-glazed and selective surface flat plate collectors are examined.

M.S.K

A83-40523

PERFORMANCE TEST PROCEDURES FOR THERMAL COLLECTORS - OUTDOOR TESTING

W. B GILLET (University College, Cardiff, Wales) IN: Performance of solar energy converters Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 103-124. refs

A review of outdoor solar collector test methods is presented, based largely on the CEC Recommendations for European Solar Collector Test Methods. Test facility design and instrumentation are discussed, with reference to their influence on measured collector efficiencies. Steady state outdoor testing, mixed indoor/outdoor testing and transient testing are reviewed, and it is concluded that although the testing of simple flat plate water heaters is fairly well understood, more work is now required to develop test methods for the new high performance collectors which are coming onto the market.

Author

A83-40524

PERFORMANCE TEST PROCEDURES FOR THERMAL COLLECTORS - SOLAR SIMULATORS

W. B. GILLET (University College, Cardiff, Wales) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 125-146. refs

The design and use of solar simulators is reviewed in the light of the experience reported by participants in the collaborative collector testing programmes of Commission of the European Communities and the International Energy Agency. Experience with the Compact Source Iodide lamp at Cardiff is used to illustrate the need for correcting both outdoor and solar simulator test results to reference conditions of solar and thermal irradiance. It is suggested that further work is required on the development of procedures for predicting typical outdoor performance from solar simulator measurements where collectors contain new materials or complex geometries. Author

A83-40525

PHOTOVOLTAIC ENERGY CONVERTERS

W. H. BLOSS (Stuttgart, Universitaet, Stuttgart, West Germany) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 147-162.

The operational principles and numerical models for various significant parameters of solar cell performance are explored. Photovoltaics are semiconductor materials which experience quantum electronic transitions when a photon is absorbed. Electron hole pairs produced have a potential that can be converted into electrical energy. The photon energy must exceed the band-band transition energy band gap of the material for the absorption to occur. Each semiconductor material, e.g., Si, GaAs, CdS, etc., used for solar cells features a particular absorption coefficient, and production economies are partially dependent on the development of cells which are thinner and have a broad spectral response, such as found with amorphous Si. The functional characteristics of the junction between layers of a photovoltaic cell are also significant for the cell efficiency, as are the cell temperature and wiring interconnection with other cells. The maximum power delivered is a function of the fill factor, short circuit current, and open circuit voltage. The total efficiency can be augmented through concentrating configurations and by manufacturing tandem cells, which permit efficiencies of 30 percent. M.S.K.

A83-40526

PERFORMANCE TEST PROCEDURES FOR SOLAR CELLS AND MODULES

F. C. TREBLE IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 163-187. refs

Solar cell module performance rating techniques are described, noting their inclusion as a European Standard Specification. The significant parameters measured include the voltage-current characteristic, the spectral response, the temperature dependence of the efficiency, and the internal series resistance. The modules are tested outdoors and/or in illumination of 1000 W/sq m. The measured performance of the module can then be compared with reference solar cell modules manufactured specifically for the purpose of comparisons. Implementation of the techniques is a means of achieving an accuracy of within 2 percent reproducibility when rating the module performance. M.S.K.

A83-40527

SOLAR CELL AND MODULE PERFORMANCE ASSESSMENT BASED ON INDOOR CALIBRATION METHODS

K. BOGUS (ESA European Space Research and Technology, Centre, Noordwijk, Netherlands) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 189-219. refs

A combined space/terrestrial solar cell test calibration method that requires five steps and can be performed indoors is described. The test conditions are designed to qualify the cell or module output data in standard illumination and temperature conditions. Measurements are made of the short-circuit current, the open circuit voltage, the maximum power, the efficiency, and the spectral response. Standard sunlight must be replicated both in earth surface and AM0 conditions; Xe lamps are normally used for the light source, with spectral measurements taken of the light. Cell and module spectral response are assayed by using monochromators and narrow band pass monochromatic filters. Attention is required to define the performance characteristics of modules under partial shadowing. Error sources that may affect the measurements are discussed, as are previous cell performance testing and calibration methods and their effectiveness in comparison with the behaviors of satellite solar power panels. M.S.K.

A83-40528

METHOD FOR A RELIABILITY STUDY ON PHOTOVOLTAIC MODULES APPLICATION FOR THE QUALIFICATION OF CELLS AND MODULES

A. DESOMBRE (Photowatt International S.A., Caen, France) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 221-234.

The different steps used to determine the reliability of a solar cell are described and their effectiveness in predictions of cell lifetime are discussed. Commercially acceptable solar cells must last an average of 20 yr in various climatic conditions and in different applications. Testing is performed after characterizing the stresses to which the cells will be exposed, including climatic, electrical, and mechanical factors. Cell failures can be either catastrophic, i.e., total functional cutoff, or drift failure, a gradual decrease in productivity. Accelerated stresses are applied to cells as a means of measuring the long-term behavior, and various module components are also exposed to conditions that simulate possible failure-producing mechanisms or combinations of agents, such as humidity leading to eventual output degradation from corrosion. Specific test configurations are necessary to study module and cell performance whenever the units are intended for installation in extreme climatic situations, e.g., jungles or deserts. M.S.K.

A83-40530

THE SOLAR TEST FACILITY LS-1 - TECHNICAL DESCRIPTION

G. BLAESSER, H. HETTINGER, K. KREBS, S. PACE, A. J. PRINS, and E. ROSSI-GIANOLI (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981. Dordrecht, D. Reidel Publishing Co., 1983, p. 259-295.

An indoor solar cell module and collector test facility, LS-1, operated by Ispra is described. A multiple lamp system is employed to produce a uniform and uncollimated light distribution on a flat test plane located in a climatic chamber. Numerical models have been devised to quantify the intensity falling on the test plane in any inclination. A mirror channel reflects the light onto the test plane, with the intensity being controlled by the number of lamps turned on. Automated monitoring equipment collects data for the output and cell performance parameters, flow rates through a solar flat plate collector panel, wind speeds simulated in the chamber, and temperatures of all components and fluids. M.S.K.

A83-40531

QUALIFICATION AND DURABILITY TESTS - APPLICATIONS FOR THERMAL COLLECTORS AND PHOTOVOLTAIC MODULES

G. RIESCH (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN Performance of solar energy converters Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 297-325. refs

Accelerated and abbreviated durability tests for characterizing the long-term reliability of solar thermal and photovoltaic modules are described. The tests have been designed to provoke behaviors which would normally require years to become manifest, thereby allowing lifetime predictions to be made over a short testing period. Increasing the intensity of the potentially damaging agent, e.g., UV radiation, humidity, a combination of both, is one method, and cycling the specimen through exposures and out of them in repetitive rapid succession, such as in thermal cycling, is another. The two techniques can also be combined. Solar flat plate collectors are presently tested for overpressure resistance of the absorber, leak tests, rain penetration, load carrying capacity, resistance to hail impact, and durability under thermal shock. Trials are also run involving exposure to a dry atmosphere, UV radiation, ozone-contaminated atmosphere, sulfur dioxide, cyclic damp heat, and salt mist. Photovoltaic modules are tested for thermal strength, in mounting twist tests, for insulation integrity, for ice loading, for humidity freezing, temperature cycling, long exposure to high temperatures, in damp heat in long storage, and to the same atmospheric factors as flat plates. M.S.K.

A83-40533

PERFORMANCE OF A HYBRID SOLAR HEATING SYSTEM OF THE SOLAR LABORATORY AT THE JRC-ISPR

D. VAN HATTEM, E. ARANOVITCH, and P. ACTIS-DATO (Commission of the European Communities, Joint Research Centre, Ispra, Italy) IN: Performance of solar energy converters. Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 337-354.

System features and the three year performance data from the solar laboratory at Ispra, which is heated by a heat pump, flat plate collectors, and storage unit are summarized. The heating system has 41 sq m of collector surface, a 50 cu m concrete hot water storage tank, a heat pump with a 17 kW capacity, a floor heating system, and a 2 cu m heat storage as a buffer for the collectors. The building requires 300 W/deg C for heating and has a peak demand of 9 kW. Chilled water is stored in the underground large tank during the summer for cooling purposes, and one month is allotted to thermally charge the tank before the winter. The addition of the heat pump and storage to the solar flat plate collector system has increased the effective energy gain of the collectors to 1190 MJ/sq m, or 2.5 times the effectiveness without the storage and heat pump. M.S.K.

A83-40534

INTRODUCTION TO THE EC SOLAR HEATING PROGRAMME

T. C. STEEMERS (Commission of the European Communities, Ispra, Italy) IN: Performance of solar energy converters: Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 355-359.

Educational, developmental, and optimization goals for performing research and development programs on solar space heating systems in Europe are discussed. It is noted that in arranging the programs concern must be given to the designers and architects who will produce the plans, since no conventional curriculum has yet been devised for solar heating design other than training in the basic tools of the designer and architect. Awareness is also necessary of the fact that off-the-shelf solar heating equipment is not yet an established facet of European industry. A Solar Pilot Test Facility has been constructed and features the capability of simulating thermal loads for testing real

flat plate collectors, storage, and controls as well as the presence of occupants and varying weather. M.S.K.

A83-40535

VALIDATION OF SIMULATION MODELS OF SOLAR HEATING SYSTEMS WITH DATA FROM THE SOLAR PILOT TEST FACILITIES

IR. P. DECEUNINCK (Leuven, Katholieke Universiteit, Louvain, Belgium) IN Performance of solar energy converters: Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 361-380. refs

Features of solar heating system computer simulation programs being developed in Europe for numerically modelling the performance of any type of solar heating system are outlined. The program is being devised to handle any type of equipment and climatic conditions, and is based on climatic data and performance records of various solar collector systems operated in European climatic zones. An algorithm has been defined to yield a fourth order Runge-Kutta integration of differential equations comprising a state vector, the climatic conditions, the system capabilities, and system losses. A statistical validation scheme for short term performance predictions locates faults in the predictions, and statistical errors can also be computed for long-term performance predictions. Finally, a simplified version is being developed against a background of previous models written on analytical, empirical, or hybrid bases. M.S.K.

A83-40536

THE PHOTOVOLTAIC PILOT PROJECTS OF THE EUROPEAN COMMUNITY

W. SCHNELL (Commission of the European Communities, Brussels, Belgium) IN Performance of solar energy converters: Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 381-390.

The Commission of the European Communities has started in 1980 a programme for the design and construction of a series of photovoltaic pilot projects in the range of 30-300 kWp. Virtually all important industries and other development organisations in Europe working on photovoltaic cells and systems are involved in this programme. The different technologies which are being developed concern the modules, the cabling of the array, structure design, storage strategy and power conditioning. The various applications include powering of an island, villages, recreation centres, water desalination and disinfection, powering of radio transmitters, emergency power plants, dairy farm, training school, cooling, water pumping, powering of a solar heated swimming pool and last but not least, hydrogen production. Author

A83-40537

RECOMMENDATIONS FOR EUROPEAN SOLAR COLLECTOR TEST METHODS (LIQUID HEATING COLLECTORS)

A. DERRICK and W. B. GILLET (University College, Cardiff, Wales) IN: Performance of solar energy converters: Thermal collectors and photovoltaic cells, Lectures of the Course, Ispra, Italy, November 11-18, 1981 . Dordrecht, D. Reidel Publishing Co., 1983, p. 393-467. refs

Standardized testing formats, equipment, conditions, and tests defined as part of the solar flat plate collector testing program performed by the Commission of the European Communities are detailed. The work is a product of efforts at 20 laboratories, and alternative methods have been characterized for tailoring tests to particular locations and climatic conditions. The testing methods are intended for collectors using a liquid as the heat transfer medium. Procedures have been defined for examining steady state and transient performance, heat loss, thermal capacity, pressure drop, and anemometry. Instrumentation types and accuracies have been defined, and a standardized format for presentation of results has been developed. The tests are tailored for determining the durability of the flat plate systems under simulated solar radiation conditions. M.S.K.

N83-23588*# Florida Univ., Gainesville.

RESEARCH ON SOLAR PUMPED LIQUID LASERS Annual Progress Report, 1 Jan. - 31 Dec. 1982

R. T. SCHNEIDER, U. H. KURZWEG, J. D. COX, and N. H. WEINSTEIN Mar. 1983 34 p refs
(Contract NAG1-135)
(NASA-CR-170298, NAS 1.26:170298) Avail: NTIS HC A03/MF A01 CSCL 20E

A solar pumped liquid laser that can be scaled up to high power (10Mw CW) for space applications was developed. Liquid lasers have the inherent advantage over gases in that they provide much higher laser densities and thus high power densities. Liquids also have inherent advantages over solids in that they have much higher damage thresholds and are much cheaper to produce for large scale applications. Among the liquid laser media that are potential candidates for solar pumping, the $\text{POC13-Nd(3+)-ZrC14}$ liquid was chosen for its high intrinsic efficiency as well as its relatively good stability against decomposition due to protic contamination. The development and testing of the laser liquid and the development of a large solar concentrator to pump the laser was emphasized. The procedure to manufacture the laser liquid must include diagnostic tests of the solvent purity (from protic contamination) at various stages in the production process.

S.L.

N83-23700*# Materials Research, Inc., Centerville, Utah.

ANALYSIS OF DEFECT STRUCTURE IN SILICON. CHARACTERIZATION OF SEMIX MATERIAL. SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SILICON SHEET TASK OF THE LOW-COST SOLAR ARRAY PROJECT Final Report

R. NATESH, G. B. STRINGFELLOW, A. V. VIRKAR, J. DUNN, and T. GUYER Feb 1983 138 p refs
(Contract JPL-955676)
(NASA-CR-170239, JPL-9950-808, DOE/JPL-955676-4; NAS 1.26:170239) Avail: NTIS HC A07/MF A01 CSCL 10A

Statistically significant quantitative structural imperfection measurements were made on samples from ubiquitous crystalline process (UCP) Ingot 5848 - 13C. Important correlation was obtained between defect densities, cell efficiency, and diffusion length. Grain boundary substructure displayed a strong influence on the conversion efficiency of solar cells from Semix material. Quantitative microscopy measurements gave statistically significant information compared to other microanalytical techniques. A surface preparation technique to obtain proper contrast of structural defects suitable for quantitative image analyzer (QTM) analysis was perfected and is used routinely. The relationships between hole mobility and grain boundary density was determined. Mobility was measured using the van der Pauw technique, and grain boundary density was measured using quantitative microscopy technique. Mobility was found to decrease with increasing grain boundary density.

Author

N83-23701*# Illinois Tool Works, Inc., Elgin. Venture Group.

ION-PLATING OF SOLAR CELL ARRAYS ENCAPSULATION TASK: LSA PROJECT 32 Final Report

J. C. VOLKERS 1983 37 p refs
(Contract JPL-955506)
(NASA-CR-170244; JPL-9950-815; DOE/JPL-955506-83/3, NAS 1.26:170244) Avail: NTIS HC A03/MF A01 CSCL 10A

An ion plating process by which solar cells can be metallized and AR coated, yielding efficiencies equal to or better than state-of-the-art cells, was developed. It was demonstrated that ion plated AR films may be used as an effective encapsulant, offering primary protection for the metallization. It was also shown that ion plated metallization and AR coatings can be consistent with the project cost goals.

Author

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PROCEEDINGS: FOURTH PARABOLIC DISH SOLAR THERMAL POWER PROGRAM REVIEW

1 Feb 1983 340 p refs
(Contract DE-AM04-80AL-13137)
(NASA-CR-170297; DOE/JPL-1060/58; JPL-PUB-83-2; JPL-5105-122; NAS 1.26:170297) Avail: NTIS HC A15/MF A01 CSCL 10A

The results of activities within the parabolic dish technology and applications development program are presented. Stirling, organic Rankine and Brayton module technologies, associated hardware and test results to date, concentrator development and progress; economic analyses, and international dish development activities are covered. Two panel discussions, concerning industry issues affecting solar thermal dish development and dish technology from a utility/user perspective, are also included.

S.L.

N83-23709*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF THE ECONOMICS OF PHOTOVOLTAIC-DIESEL-BATTERY ENERGY SYSTEMS FOR REMOTE APPLICATIONS

W. A. BRAINARD 1983 9 p refs Presented at the Ann. Meeting of the American Solar Energy Soc., Minneapolis, 1-3 Jun. 1983
(Contract DE-AI01-79ET-20485)

(NASA-TM-83377; DOE/NASA/20485-14; E-1645; NAS 1.15:83377) Avail: NTIS HC A02/MF A01 CSCL 10C

Computer simulations were conducted to analyze the performance and operating cost of a photovoltaic energy source combined with a diesel generator system and battery storage. The simulations were based on the load demand profiles used for the design of an all photovoltaic energy system installed in the remote Papago Indian Village of Schuchuli, Arizona. Twenty year simulations were run using solar insolation data from Phoenix SOLMET tapes. Total energy produced, energy consumed, operation and maintenance costs were calculated. The life cycle and levelized energy costs were determined for a variety of system configurations (i.e., varying amounts of photovoltaic array and battery storage).

Author

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MIDTEMPERATURE SOLAR-SYSTEMS TEST FACILITY. PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA OF LOW- TO MEDIUM-TEMPERATURE LINE-FOCUSING SOLAR COLLECTORS: E-SYSTEMS, FRESNEL-LENS COLLECTOR

T. D. HARRISON Feb. 1982 20 p refs
(Contract DE-AC04-76DP-00789)
(DE82-012606; SAND-82-0092/2) Avail: NTIS HC A02/MF A01

Thermal performance predictions based on test data are presented for the E-Systems Fresnel Lens solar collector for five output temperatures at eight cities in the United States. DOE

N83-23743# European Space Agency, Paris (France).

SOLAR ENERGY 1982: RESOURCES, TECHNOLOGIES, POTENTIAL

W. R. BURKE, comp Nov 1982 256 p refs Proc. of Summer School, Igls, Austria, 28 Jul. - 6 Aug. 1982; sponsored by ESA, CNES and DFVLR
(ESA-SP-181; ISSN-0379-6566) Avail: NTIS HC A12/MF A01

The principles of solar energy conversion are reviewed. The feasibility of applying various solar technologies for the provision of heat and the generation of electricity is discussed. The advantages and disadvantages of various solar technologies are also discussed.

02 SOLAR ENERGY

N83-23744# Austrian Solar and Space Agency, Vienna.

SOLAR TECHNOLOGIES AND POTENTIAL

G. FANINGER /in ESA Solar Energy 1982: Resources, Technol., Potential p 3-9 Nov 1982
Avail: NTIS HC A12/MF A01

The rapid escalation of energy costs, the depletion of fossil fuel reserves and especially the increase of global energy requirements necessitate the utilization of all sources of energy, especially of renewables. With the present knowledge it could be expected that solar energy can play a significant role in rural areas in the form of decentralized applications. Many of the solar technologies are ready for immediate use in a multiplicity of applications. Other solar technologies are in an advanced stage of research and development and must be demonstrated, in various climatic zones, on a broad scale in order to prove their technical and economic viability

Author

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ENERGY SITUATION AND SOLAR OPTION

W HAEFELE /in ESA Solar Energy 1982: Resources, Technol., Potential p 11-13 Nov. 1982 refs
Avail: NTIS HC A12/MF A01

Solar energy as a resource for future energy supply is considered. The energy system is discussed as a whole, paying attention to market penetration mechanisms, and tenacious social infrastructures. Since electricity alone would be insufficient to meet the end users' requirements appropriately, this system supplies hydrogen via a widespread second which completes the functions of the well established electricity grid. The combination of both extremely clean secondary energies covers the total spectrum of energy applications.

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SOLAR RESOURCE

E RASCHKE /in ESA Solar Energy 1982: Resources, Technology, Potential p 17-20 Nov 1982 refs
Avail: NTIS HC A12/MF A01

The downward solar radiation at the Earth's surface is modified by scattering and absorption processes in the atmosphere and the geometry between the positions of the Sun and observer. These principles are outlined in this paper with particular attention to the use of satellite measurements for aerial inventories of available solar energy at ground

Author

N83-23749# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany)

SOLAR THERMAL CONVERSION

C. J. WINTER /in ESA Solar Energy 1982: Resources, Technol., Potential p 35-41 Nov. 1982 refs
Avail: NTIS HC A12/MF A01

A systematic description of solar energy utilization on Earth is given. The basic physics of solar energy conversion into heat by means of conduction, convection and radiation are briefly outlined. Examples of existing thermal converters and a list of potential weak-points for future investigations conclude the paper.

Author

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SOLAR ENERGY AND STORAGE

P. KESSELRING /in ESA Solar Energy 1982 Resources, Technol., Potential p 53-58 Nov 1982 refs
Avail: NTIS HC A12/MF A01

The contribution consists of two parts. The first one deals with the problem that substituting oil by solar energy implies also to find a long term storage for high quality energy. The conclusion of the rather general discussion is that solar high temperature chemistry, electrochemistry and photochemistry are probably the most important R&D fields to be emphasized in the future. In the second part mostly work done at EIR is presented. The topics sketched are remarks concerning underground heat storage, capacity determination for medium term (days to weeks) hot water

storages, the energy density in latent heat storage and a few remarks to the problem of using the grid to store (or buffer) solar (photovoltaic) electricity

Author

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SYSTEMS WITH MEDIUM AND HIGH TEMPERATURE THERMAL CONVERSION

H. F. KLEINRATH /in ESA Solar Energy 1982: Resources, Technol., Potential p 61-65 Nov. 1982
Avail: NTIS HC A12/MF A01

Solar thermal power plants are no longer a new technology. Many of their components are so called conventional equipment, some new components are out of their infancy but not yet fully developed. There are several pilot plants, but they are not in operation long enough to speak about routine. First experience does exist, but as usual much of it is just "how to do it furtheron better". The report tries to answer the following questions: what is the state of the art, of which kind are the problems still unsolved, what can be done in order to accelerate further development?

Author

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SOLAR POWER TOWERS

M C ETIEVANT /in ESA Solar Energy 1982 Resources, Technol., Potential p 67-78 Nov 1982 refs In FRENCH
Avail: NTIS HC A12/MF A01

Experimental solar power towers actually in construction or already in existence in the world are described. Seven of these installations are examined: three involve water vapor with solar superheating (EURELIOS, CESA 1, SOLAR ONE), two involve saturated water vapor (NIO, CES 5), one involves sodium (SSPS, CRS), and one molten salt (TEMIS). The principal characteristics of these receivers are presented as well as some results of economic studies of heliostat construction and the cost of electricity

A R H.

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DISTRIBUTED COLLECTOR SYSTEMS (DCS) FOR THE MEDIUM TEMPERATURE RANGE

A. C KALT /in ESA Solar Energy 1982: Resources, Technol., Potential p 81-87 Nov. 1982
Avail: NTIS HC A12/MF A01

The basic layout of a distributed collector system (DCS) is described and questions concerning design are discussed. Plant designs and performance data for four DCS systems are presented. Energy storage techniques, the power conversion cycle, and heat transfer subsystems are addressed.

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SMALL INTEGRATED SOLAR ENERGY SYSTEMS FOR DEVELOPING COUNTRIES

K. R. SCHREITMUELLER /in ESA Solar Energy 1982: Resources, Technol., Potential p 89-95 Nov 1982 refs
Avail: NTIS HC A12/MF A01

Solar energy applications in developing countries cover processing of food and other agricultural products, fresh water production, operation of cooling and freezing equipment, of water pumps and processing machinery. Evacuated tubular collectors turn out to be best suited for process heat generation, photovoltaic generators for electricity production. The Mexican fisher village of Las Barrancas gives a good example of an integrated solar energy system.

Author

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PHOTOVOLTAIC ENERGY CONVERTERS: FUNDAMENTALS AND ADVANCED CONCEPTS

W. H. BLOSS /in ESA Solar Energy 1982: Resources, Technol., Potential p 99-103 Nov. 1982

Avail: NTIS HC A12/MF A01

The basic physics of photovoltaic energy conversion devices based on semiconductors is outlined. The significant role of the solar spectrum and of the material parameters absorption coefficient and diffusion length of the semiconductors as well as the consequences with respect to material selection are discussed. The potentials of conventional flat plate and concentrating systems and the special advantages of advanced systems such as tandem configurations and those including dispersive and concentrating elements are outlined

Author

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SILICON SOLAR CELLS FOR FLAT PLATE PHOTOVOLTAIC SYSTEMS

M. RODOT /in ESA Solar Energy 1982: Resources, Technol., Potential p 105-110 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The best cost effective solar cells (8 to 10 watt) are made of crystalline silicon. Their evolution is based on the emergence of a new material, solar grade Si, which is less pure and perfect than the electronic grade material used today. The physics, chemistry, and crystal growth aspects of solar grade Si are discussed. Together with other improvements, this material allows a cost of 3 to 4 \$/watt in 1985 and brings photovoltaic generators in close competitiveness with diesel engines. Amorphous Si is also briefly mentioned.

Author

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CONCENTRATING PHOTOVOLTAIC SYSTEMS

A. DUPAS /in ESA Solar Energy 1982: Resources, Technol., Potential p 113-121 Nov. 1982

Avail: NTIS HC A12/MF A01

Various configurations for concentrating photovoltaic systems are described and their operating principles are explained. The effects of temperature and series resistance on system efficiency are discussed. As an example, the french family of photovoltaic concentrating systems, SOPHOCLE, is described. The SOPHOCLE family of generators is characterized by the use of a heliostat with altazimuth mounting and by the choice of medium concentration ($C=45$) by fresnel lenses on silicon cells

M.G.

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PHOTOVOLTAIC APPLICATIONS

H. GROTH /in ESA Solar Energy 1982: Resources, Technol., Potential p 135-145 Nov. 1982 refs

Avail: NTIS HC A1/MF A01

The utilization of photovoltaic generators in measuring and signalling installations, communication systems, water pumping, and electric power plants is discussed. The advantages of solar generators over conventional power supply equipment are outlined

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ON THE ECONOMICS OF SOLAR ELECTRICITY GENERATION

J. GRETZ /in ESA Solar Energy 1982: Resources, Technol., Potential p 147-148 Nov. 1982

Avail: NTIS HC A12/MF A01

The development of solar electricity cost models is discussed. In view of the large scattering of component and total plant investment costs, differences in mode of cost calculation, and uncertainty of the solar utilization factor refined cost calculations do not give any more useful information than simple formulae. The competitiveness of solar electricity is addressed with reference to cost projections.

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SOCIO-ECONOMICS OF SOLAR ENERGY

P. A. BUIGUES /in ESA Solar Energy 1982: Resources, Technol., Potential p 151-157 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The economic and social status of new and renewable energy sources in the United States and in France is described. The roles of different strategic agents (companies and government) in developing and using these energy resources is also outlined.

Author

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TWO ALTERNATIVE SOLAR ENERGY SCENARIOS FOR WESTERN EUROPE

N. NAKICENOVIC /in ESA Solar Energy 1982: Resources, Technol., Potential p 159-163 Nov. 1982 refs

Avail: NTIS HC A01/MF A01

Two limiting scenarios that lead to a sustainable energy system in Western Europe toward the end of the next century are described. The scenarios consider exclusively solar energy futures: one based on centralized solar technologies (hard scenario) and the other on decentralized user-oriented technologies (soft scenario). While both scenarios eliminate Western Europe's dependence on domestic and foreign fossil energy sources, the hard solar scenario requires substantial imports of solar produced hydrogen. Fundamental but different changes of the whole energy system, economic structure and lifestyles are necessary in order to achieve sustainable solar energy futures in the scenarios.

M.G.

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PHOTOVOLTAIC APPLICATIONS IN EUROPE: SYSTEM ECONOMICS AND MARKET PROSPECTS

M. R. STARR /in ESA Solar Energy 1982: Resources, Technol., Potential p 165-170 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

After reviewing the prospects for cost reduction, the economics of electricity generation by photovoltaics in comparison with conventional alternatives are discussed. The important influence of various financial incentives for purchasers is demonstrated. Economic analyses are also presented for small-scale stand-alone photovoltaic systems for pumping and refrigeration. Finally, the market prospects for photovoltaic applications in Europe are reviewed, on the assumption that this technology is given official support and encouragement by national governments, electricity utilities and private investors.

R.J.F.

N83-23767# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Research Dept.

LARGE SCALE SOLAR ENERGY UTILIZATION POSSIBILITIES AND RESTRICTIONS

J. NITSCH /in ESA Solar Energy 1982: Resources, Technol., Potential p 179-184 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The basic problems of producing hydrogen and introducing it into our energy system are described. It is discussed in what time and under which conditions solar hydrogen can make an essential contribution to our energy economy. Solar thermal and photovoltaic power plants for the electrolytic production of hydrogen are described. Typical values for the amount of the financial investment as well as for the raw material requirements are given. It is concluded that sizeable portion (up to 50%) of our energy could be supplied by solar hydrogen in the year 2030.

R.J.F.

02 SOLAR ENERGY

N83-23768# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany) Advanced Programs Div.

OTHER MEANS FOR DIRECT AND INDIRECT USE OF SOLAR ENERGY

W. LEY /in ESA Solar Energy 1982. Resources Technol., Potential p 185-190 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The direct and indirect uses of solar energy are discussed. Indirect solar energy conversion like wind, wave and tides, water flows or elevated water, ocean thermal and biological materials are considered. All of them are of interest today as possible future energy sources primarily because of their nondepletable character and their favorable environmental aspect, in comparison with energy technologies presently in use. R.J.F.

N83-23769# European Space Research and Technology Center, Noordwijk (Netherlands). Systems Engineering Dept.

SOLAR POWER SATELLITES: A REVIEW OF THE STATE OF RESEARCH

D. KASSING /in ESA Solar Energy 1982: Resources, Technol., Potential p 191-197 Nov 1982 refs

Avail: NTIS HC A12/MF A01

Main results of the recently completed Solar Power Satellite concept development and evaluation studies in the U.S. and of additional studies in Europe are reviewed in respect to the technical feasibility, economic practicality, and social and environmental acceptability of the concept. Possible consequences for Europe for future research and development in related areas are discussed. Emphasis is given to the photovoltaic reference system used as a strawman concept in the U.S. comparative assessment. Some other advanced photovoltaic satellite concepts with promising benefits against the reference system are also reported. R.J.F.

N83-23770# European Space Agency, Paris (France)
ROUND TABLE DISCUSSION ON THE FUTURE OF SOLAR ENERGY

A. S. STRUB, W. H. BLOSS, M. CLAVERIE, G. FANINGER, and C. J. WINTER /in *its* Solar Energy 1982: Resources, Technol., Potential p 201-204 Nov 1982

Avail: NTIS HC A12/MF A01

The future of solar energy technology in industrialized countries and developing nations was discussed. Solar technologies were compared. Policies, trends, and efforts in various countries were discussed. A review of photosynthesis was given. R.J.F.

N83-23772# Austrian Solar and Space Agency, Vienna
WORKSHOP 2: OPTIMIZATION OF SOLAR HEATING SYSTEMS

M. BRUCK /in *its* Solar Energy 1982. Resources, Technol., Potential p 215-220 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The life cycle cost method was used to investigate the solar domestic hot water preparation economic sensitivity in Austria, the Federal Republic of Germany and France. The life cycle savings of a solar heating system over a conventional heating system are expressed as the difference between a reduction of conventional fuel costs and an increase in expenses incurred as a result of the additional investment for the collector system. R.J.F.

N83-23773# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).

WORKSHOP 3: CENTRAL RECEIVER SYSTEMS

M. BECKER, M. C. ETIEVANT (Ecole Centrale des Arts et Manufactures), and J. GRETZ (Joint Research Centre of the European Communities) /in ESA Solar Energy 1982: Resources, Technol., Potential p 221-223 Nov. 1982

Avail: NTIS HC A12/MF A01

The basic design data is given for a 5 MW sub el solar thermal power tower. Specifications are for the geographical and meteorological conditions of Almeria, Spain. The objectives were to consider the total system, to understand contexts and possible

options, to discuss technical consequences, and finally to decide upon reasonable solutions R.J.F.

N83-23774# European Space Agency, Paris (France)

WORKSHOP 4: DESIGN OF A 100 KWE DCS SOLAR POWER PLANT

in ESA Solar Energy 1982 Resources, Technol., Potential p 227-230 Nov. 1982 refs

Avail: NTIS HC A12/MF A01

The design of a 100 kWe solar generator is discussed. The rough design of the steam circuit is discussed, as is the choice of a temperature range for the collector and storage medium. The layout of the collector field and heat storage tanks are given. Heat losses are calculated. R.J.F.

N83-23775# Centre National de la Recherche Scientifique, Lyon (France). Dept. de Physique des Materiaux

WORKSHOP 5: DESIGN OF A PHOTOVOLTAIC GENERATOR FOR A REFUGE IN THE ALPS

J. A. ROGER /in ESA Solar Energy 1982 Resources, Technol., Potential p 231-234 Nov 1982 refs

Avail: NTIS HC A12/MF A01

The design of a photovoltaic (PV) generator for a refuge located in the mountains (+5 deg north, 4 deg east) at an altitude of 2600 m is discussed. This refuge has a capacity of 90 persons and is not connected to the grid. It is at present equipped with a 14 kVa diesel generator operating in a three phase plus neutral mode. This group provides electricity to various domestic appliances, lighting, heat (in the keeper's room), refrigeration, water pumping, etc. Starting from available documents and data, the task was to design the PV generator to be substituted for this diesel engine. The work was divided in several steps: analysis of the existing loads and of the corresponding consumptions; estimation of the solar energy available on the site; choice of the PV chain necessitating as few modifications as possible in the existing installation; sizing of the elements of the PV chain and scheme of the various parts; and modifications that can be done regarding the loads, and related changes in the design of the system. R.J.F.

N83-23778# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany) Abt. EPS.

SOLAR THERMAL POWER PLANT 30/50 KWE. GERMAN-SPANISH COOPERATION PROJECT AUXINI/M.A.N. Final Report, Feb. 1982

M. KRAFT Bonn Bundesministerium fuer Forschung und Technologie Nov 1982 48 p /in GERMAN; ENGLISH summary

(BMFT-FB-T-82-198; ISSN-0340-7608) Avail NTIS HC A03/MF A01, Fachinformationszentrum, Karlsruhe, West Ger. DM 10

The development of solar farm plants is discussed. A test site was built containing a testhouse, street, workshop and sufficient measurement equipment. In 1980 the test site was increased to 18,000 sq m and an additional office building was erected. The installed Solar Thermal Power Plant consists of three collector fields with a total collector area of 582 sq m a tankfarm storage system, with a capacity of 1,15 MWh th. at a temperature increment of 100 K, the primemover circuit with a screw expander about 50 KWe peakpower output and the control and supervision system. The tests are concentrated on components and the system for the production of thermal energy, which will be applied to industrial processes. E.A.K.

N83-23784# Internationale Atomreaktorbau Gesellschaft, Bensberg (West Germany)

GAS-COOLED SOLAR TOWER POWER PLANT FOR THE GENERATION OF ELECTRICAL POWER IN THE RANGE OF 20 MW (GAST). (DETAIL DESIGN PHASE 2A) Final Report, Nov. 1981

P. WEHowsKY Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 35 p refs *In* GERMAN; ENGLISH summary

(BMFT-FB-T-82-208; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 7,50

The detail design phase of a 20 MWe gas cooled solar tower power plant (GAST) was examined. The goal of phase 2/2A was the detail engineering and design of the reference concepts of plant system and subsystems developed within the preliminary design phase and to start test work required for the erection of the pilot plant. The construction of a pilot plant, originally planned to be finished within a very short time, can not be continued.

E.A.K.

N83-23785# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany) Neue Technologien Energietechnik

PROTOTYPE DEVELOPMENT FROM A 10 KW SMALL SOLAR POWER PLANT. PHASE 3A Final Report, Dec. 1981

J. HAENFLING and R. VEIGEL Bonn Bundesministerium fuer Forschung und Technologie Dec 1982 113 p *In* GERMAN; ENGLISH summary

(BMFT-FB-T-82-209; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 24

The prototype development modification of a small solar power plant in Cairo, Egypt is described. The following stages are discussed: introduction and supervising of the Egyptian mechanical engineers and technicians; integration and testing of the screw expansion engine, fitting and optimization of the regulating system; planning for the further application of the small solar power plant, and planning for the comprehensive training program solar power plant in Cairo for engineers, technicians and mechanics

E.A.K.

N83-23787# Flachglass A.G. DELOG-DETAG, Gelsenkirchen (West Germany). Beschichtungslabor.

DEVELOPMENT OF A SELECTIVE THIN FILM AND OF A HERMETICALLY SEALED FLAT PLATE SOLAR COLLECTOR WITH GAS FILLING Final Report, Dec. 1980

W. ZERNIAL Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 91 p refs *In* GERMAN, ENGLISH summary

(BMFT-FB-T-82-214; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 19

The industrial productivity of a selective absorbing thin film was investigated on the basis of reactive cathodic sputtering of Ni. On substrates of 1.8 sq m of Al, Cu, steel and stainless steel, solar absorption values up to 97% were achieved at emissivities of 5 to 10%. A prototype flat plate collector for high temperatures with two covers and hermetical sealing was developed. The technical data of the collector were measured, dependent on the selectivity of the absorber, gas fillings of dry air, argon or SF₆ and the geometry and were compared with those of an evacuated flat plate collector. A hermetical sealed double flat plate collector for low temperatures was developed which has the advantage of lower no load temperatures and higher energy gain for heating swimming pool water compared with a conventional flat plate collector. The insulation values on collectors were measured and were used for a calculation of the energy gains of different collector types. S.L.

N83-23810# Carrier Corp., Syracuse, N.Y. Energy Systems Div. **AIR COOLED ABSORPTION CHILLERS FOR SOLAR COOLING APPLICATIONS**

W. J. BIERMANN and R. C. REIMANN *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 59-61 Mar. 1982

(Contract EG-77-C-03-1587)

Avail: NTIS HC A11/MF A01

The chemical composition of a 'best' absorption refrigerant system is identified, and those properties of the system necessary to design hot water operated, air cooled chilling equipment are determined. Air cooled chillers from single family residential sizes into the commercial rooftop size range are designed and operated. S.L.

N83-23811# Carrier Corp., Syracuse, N.Y. Energy Systems Div. **WATER COOLED ABSORPTION CHILLERS FOR SOLAR COOLING APPLICATIONS**

W. J. BIERMANN and R. C. REIMANN *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 62-64 Mar. 1982

Avail: NTIS HC A11/MF A01

A broad line of absorption chillers designed to operate with hot fluids at as low a temperature as practical while rejecting heat to a stream of water was developed. A packaging concept for solar application in which controls, pumps, valves and other system components could be factor assembled into a unitary solar module was investigated. S.L.

N83-23813# EIC, Inc., Newton, Mass.

SOLAR HEATING AND COOLING WITH THE CaCl₂-CH₃OH CHEMICAL HEAT PUMP

P. O. OFFENHARTZ *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 75-77 Mar 1982 refs

Avail: NTIS HC A11/MF A01

A chemical heat pump based on the reaction of calcium chloride and methanol is being designed and optimized for solar heating and air conditioning, primarily for the residential and light commercial market. The performance requirements for this application are quite stringent. For example, to minimize maintenance, a cooling tower should not be used, and the solar collectors should be fixed rooftop flat plates or evacuated tubes. The chiller should be capable of reaching 45 F on a 95 F day in order to provide effective dehumidification. Energy storage for late afternoon and early evening cooling, as well as night time winter heating, must be provided. S.L.

N83-23820# Lincoln Lab., Mass. Inst. of Tech., Lexington.

SOLAR HYBRID ENERGY PROGRAM

E. KERN *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 108-110 Mar. 1982 refs

(Contract DE-AS01-77CS-34577)

Avail: NTIS HC A11/MF A01

During the design phase of the project a preferred residential heat pump and collector configuration was identified for both northern and southern climate locations. The preferred collectors PV or PV/T were identified for each location. Experimental data were used to quantify a temperature 'defect' which may exist in previous simulations involving air-source heat pumps. Laboratory data were obtained which show that the steady-state operations of an air-source heat pump and a utility-interactive PV power system are compatible. Substantial data from a residential prototype system were obtained. These data establish the reliability and effectiveness of the combined heat pump and PV power system. It was demonstrated that the secondary heat pump functions of 'boosting' and domestic hot water heating are difficult to perform effectively at low compressor speed. Author

02 SOLAR ENERGY

N83-23825# United Technologies Corp., East Hartford, Conn
DEVELOPMENT OF A SOLAR-POWERED RANKINE CYCLE HEAT PUMP

F. R. BIANCARDI, G. MELIKIAN, and J. W. SITLER *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 147-151 Mar 1982
(Contract DE-AC03-77CS-34510)
Avail: NTIS HC A11/MF A01

The first prototype 18-ton solar-powered turbocompressor heat pump module was successfully designed, built and tested for more than 250 hr in a specially-designed laboratory facility at UTRC Operation in both the cooling and heat pump mode was demonstrated over a wide range of building, climatic, and collector/storage conditions The design point performance of the heat pump in both the cooling and heat pump modes was confirmed, and performance mapping of the module completed. The heat pump demonstrated the wide operating range possible (using 200 to 300 F hot water) and high heat pump mode performance levels, such as a COP of 1.4 to 2.5 and 500,000 Btu/hr capacity In cooling, a COP of 0.5 to 0.75 and up to 20 tons was demonstrated. In a simulation of operation in an actual building, the heat pump smoothly and accurately followed the building load for a full day A detailed assessment of the individual module components was completed and performance, cost and reliability improvements were identified No evidence of R11 decomposition or component wear or corrosion was found.

Author

N83-23827# Oklahoma State Univ., Stillwater
PERFORMANCE MONITORING OF A GROUND-COUPLED SOLAR ASSISTED HEAT PUMP SYSTEM

J. D. PARKER *In* DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 166-169 Mar. 1982 refs
Avail: NTIS HC A11/MF A01

Approximately five months of good data have been collected and studied. These data are for November 1980 through April 1981. Some of these data have been processed and analyzed They show reductions in both energy consumption and in peak demand for the ground and solar assisted ground systems. A simulation program has been written to help analyze the data in a more meaningful way This program simulates the building, the heat pump system, the ground source exchanger and when needed, the solar loop

Author

N83-23844# Commissariat a l'Energie Atomique, Cadarache (France). Dept de Biologie
HELIO SYNTHESIS: A SOLAR BIOTECHNOLOGY BASED ON DIRECT BIOCONVERSION OF SOLAR ENERGY BY PHOTOSYNTHETIC CELLS

C. GUDIN *In* Midwest Research Inst Biotechnol for the Production of Chem and Fuels from Biomass p 113-120 Dec 1982 refs
Avail: NTIS HC A09/MF A01

Certain limiting aspects of current technology should be studied, such as the lifetimes of tubing material and the utilization of renewable sources of energy for pumping. Only exocellular or cellular biomass with high specific value, involving small markets and small plant areas (less than 1 ha), will be economically possible for the short term and will allow improvement of this technology A valorization of the totality of photosynthetic biomass with respect to economics and energy is an absolute necessity There is an immediate need for genetic studies of microalgae that will allow enhancement or even creation of chemical production satisfying economic and energy needs. Such efforts should permit the rapid establishment of an aggressive and sophisticated solar biotechnology that integrates scientific and technical developments to meet the new needs of humanity for food, chemicals, and energy, thereby complementing agriculture with a sort of cellular horticulture

Author

N83-23854# Washington Univ., Seattle. Office of the Aerospace and Energetics Research Program

HIGH-TEMPERATURE INTEGRATED THERMAL-ENERGY-STORAGE SYSTEM FOR SOLAR-THERMAL APPLICATIONS Final Report

A. P. BRUCKNER and A. HERTZBERG Dec 1982 112 p refs

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE83-004755, SERI/STR-231-1812) Avail: NTIS HC A06/MF A01

An analysis is presented of a novel, very high temperature solar thermal energy storage system which uses molten slag as the storage medium Slat bead aggregate is melted in a solar central receiver and stored in liquid form at 16500K in an insulated refractory storage vessel Sensible heat is extracted from the molten slag in a direct-contact droplet heat exchanger, in which the slag is sprayed as a multitude of droplets through a high pressure counter-flowing working gas The heated gas is used in a high-temperature regenerative Brayton cycle. The solidified slag droplets are returned to the solar receiver to repeat the cycle. Capital cost and present worth revenue requirement data are developed from a 10 MW sub e point-design electric power system for 1, 6, 15, and 48 hour storage.

DOE

N83-23860# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst

ANALYSIS OF THERMAL-STORAGE SYSTEMS

R J COPELAND Aug 1982 8 p Presented at the Energy Storage Contractors Rev. Meeting, Arlington, Va., 23-26 Aug. 1982

(Contract DE-AC02-77CH-00178, EG-77-C-01-4042)

(DE82-020981, SERI/TP-252-1685; CONF-820827-22) Avail: NTIS HC A02/MF A01

During FY 1982, thermal storage systems were analyzed for solar thermal applications Promising thermal storage concepts were identified for a liquid metal receiver in an electric power application Both an advanced, high-temperature (1100 C maximum) molten salt system and a double-effort solar cooling system were assessed. Both systems with associated thermal storage were promising. Currently, a long duration storage system with a molten nitrate salt central receiver is being assessed

DOE

N83-23871# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

LINE-FOCUS RECEIVER HEAT LOSSES

D. A DOUGHERTY Jul. 1982- 36 p refs

(Contract DE-AC02-77CH-00178, EG-77-C-01-4042)

(DE82-019165; SERI/TR-632-868) Avail: NTIS HC A03/MF A01

The results are presented by laboratory experiments made to determine the magnitude of thermal losses characteristic of several line-focus receiver designs as functions of the absorbing surface temperature and to determine which configurations are most effective in reducing receiver heat losses Designs tested were a simple glass-jacketed receiver, a back-reflecting receiver, a back-insulated receiver, and an evacuated jacket receiver. The evacuated jacket receiver demonstrated very low heat losses, but would have to be operated at very high temperatures and could be marked by some cost-effective design techniques into receivers, designers can make collectors and total systems more efficient and more competitive with other designs.

DOE

N83-23872# New Mexico Univ., Albuquerque Dept. of Mechanical Engineering

EXPERIENCE WITH THERMAL STORAGE IN TANKS OF STRATIFIED WATER FOR SOLAR HEATING AND LOAD MANAGEMENT

M. W. WILDIN, M. P. WITKOFISKY (Knolls Atomic Power Lab., Schenectady, N.Y.), J. M. NOBLE (Public Service Co. of N. Mex., Albuquerque), R. E. HOPPER (Bridgers and Paxton Consulting Engineers, Inc., Albuquerque, N. Mex.), and P. G. STROMBERG 1982 17 p Presented at the ASHRAE Natl Meeting, Toronto, 27 Jun 1982

(Contract W-7405-ENG-26)

(DE82-017421; CONF-820664-2) Avail: NTIS HC A02/MF A01

Results have been obtained for performance of stratified tanks of water used to store heating and cooling capacity in a 5574 sq m university building. The major sources of energy used to charge the heated tanks were solar energy, obtained via collectors on the roof of the building, and excess heat recovered from the interior of the building via thermal storage and electric-driven heat pump/chillers. Through stratification of the water in the storage tanks and an appropriate system operating strategy, 40 percent of the building's total heating needs were supplied by solar energy during the first four months of 1981. Month-long thermal efficiencies of the storage array ranging from 70 percent during the heating season to nearly 90 percent during the cooling season, were measured. Work is underway to improve the performance of thermal storage. DOE

N83-23873# Midwest Research Inst., Golden, Colo Solar Energy Research Inst.

SERI SOLAR ENERGY STORAGE PROGRAM Annual Report

F. BAYLIN, R. J. COPELAND, A. KOTCH, T. KRIZ, W. LUFT, R. G. NIX, and J. O. WRIGHT May 1982 67 p refs

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE82-019161; SERI/PR-231-1570) Avail: NTIS HC A04/MF A01

Thermal energy storage technologies are identified for specific solar thermal applications. The capabilities and limitations of direct-contact thermal storage and thermochemical energy storage and transport are examined. Storage of energy from active solar thermal systems for industrial process heat and the heating of buildings is analyzed and seasonal energy storage is covered. The coordination of numerous thermal energy storage research and development activities is described. DOE

N83-23874# Midwest Research Inst., Golden, Colo
INTERFACES IN SOLAR-ENERGY MATERIALS

A. W. CZANDERNA Feb. 1982 18 p refs Presented at Electrochem Soc Conf, Denver, Colo., 11 Oct. 1981

(Contract DE-AC02-77CH-00178)

(DE82-008680, SERI/TP-255-1499) Avail: NTIS HC A02/MF A01

The importance is summarized of various methods for studying the stability of interfaces in solar energy materials and of the interfaces. An overview is given that explains why interfaces are crucially important for developing long-life, cost-effective, multi-layers, polycrystalline, thin-film stacks for solar energy conversion systems (SECS). Second broad categories of characterization methods, approaches, and processes in interface science are reviewed and related to studies for components in SECS, in which the importance of compositional analysis of interfaces is emphasized. These include surface area, real and clean surfaces, structure and topography, interface composition or purity, surface thermodynamics, diffusion, amount absorbed, and nature of adsorbate/solid interactions. Third, an overview is given for the solar-related research needs and opportunities in various topical areas in interface science. DOE

N83-23876# California Univ., Livermore. Lawrence Livermore Lab.

OVERVIEW OF SOLAR-ENERGY SYSTEMS FOR ELECTRICITY PRODUCTION: COMPARISON BY COST AND EFFICIENCY

J. C. WHITEHEAD 23 Jul 1982 27 p refs

(Contract W-7405-ENG-48)

(DE82-022516, UCID-19500) Avail: NTIS HC A03/MF A01

Pertinent data are tabulated for eight solar energy conversion methods: algal biomass, agricultural biomass, biophotolysis, salt gradient solar pond, ocean thermal energy conversion, concentrated solar thermal power, silicon solar cells, and propeller wind turbines. Justifications are given for the table entries. For each system, the theoretical maximum efficiencies of the energy conversion steps are compared with actual obtained values, and attempts are made to explain the differences. DOE

N83-23878# Budd Co., Fort Washington, Pa Technical Center.
DEVELOPMENT OF SHEET-METAL PARABOLIC-TROUGH REFLECTOR PANELS

A. W. BIESTER Jun. 1982 79 p

(Contract DE-AC04-76DP-00789)

(DE82-016377; SAND-81-7038) Avail: NTIS HC A05/MF A01

Efforts to develop accurate, durable, and mass producible sheet metal parabolic trough solar collectors and the associated support for the collectors are described. The design considered is similar to an automobile hood, a two-piece sheet metal structure consisting of a formed steel frame or stiffening panel and a smooth contoured skin. The two pieces may be bonded or welded to form a rigid structure, and a reflective surface applied such as a film, glass mirror, or any of the presently utilized materials. The work encompassed material selection, adhesive selection and testing, tool design and fabrication, prototype panel production, and design and development of torque tube assemblies on which the trough is inclined. Results of adhesive bonding studies are given. It is found that high volume technology can be used to produce accurate and structurally sound reflector panels, and one configuration was selected for fabrication in suitable quantities for performance testing. DOE

N83-23880# Los Alamos Scientific Lab., N. Mex Solar Energy Group.

DOE PASSIVE-SOLAR CLASS A PERFORMANCE-EVALUATION PROGRAM: PRELIMINARY RESULTS

B. D. HUNN, W. V. TURK, and W. O. WRAY 1982 10 p refs

Presented at the Passive and Hybrid Solar Energy Update Conf., Washington, D. C., 15-17 Sep 1982

(Contract W-7405-ENG-36)

(DE82-021761, LA-UR-82-2497; CONF-820940-1) Avail: NTIS HC A02/MF A01

Elements of the plan for the DOE passive solar class A performance evaluation program are given. A proposed validation methodology, including both analytical and empirical tests, a quantitative definition of validation, minimum data requirements, and a standard reporting format, is outlined. The preliminary testing of this methodology using hourly data from two Class A test facilities is presented. Finally, the collection, analysis, and documentation of preliminary data sets is discussed. DOE

N83-23883# Oak Ridge National Lab., Tenn.

ANALYSIS OF THE HARMONICS AND POWER-FACTOR EFFECTS AT A UTILITY-INERTIED PHOTOVOLTAIC SYSTEM

G. L. CAMPEN 1982 10 p refs Presented at IEEE Power Engr Soc. Summer Meeting, San Francisco, 18 Jul. 1982

(Contract W-7405-ENG-26)

(DE82-018257; CONF-820735-2) Avail: NTIS HC A02/MF A01

The harmonics and power factor characteristics and effects of a single residential photovoltaic (PV) installation using a line commutated inverter are outlined. The data were taken during a 5 day measurement program at a prototype residential PV installation in Arizona. The magnitude and phase of various currents and voltages from the fundamental to the 13th harmonic were recorded both with and without the operation of the PV system. A candidate

method of modeling the installation for computer studies of larger concentrations is given. DOE

N83-23891# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 13: FOR NEWMAN POWER STATION, EL PASO, TEXAS
 Sep. 1982 27 p
 (Contract DE-AC04-76DP-00789)
 (DE83-000800; SAND-81-7086-13) Avail: NTIS HC A03/MF A01

The data accumulated during June at the intermediate photovoltaic project are measured. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-23892# Chicago Univ., Ill.
INTEGRATED FUNCTION NONIMAGING CONCENTRATING COLLECTOR TUBES FOR SOLAR THERMAL ENERGY Final Technical Report
 R. WINSTON and J. J. OGALLAGHER Sep. 1982 61 p refs
 (Contract DE-AC02-80ER-10558)
 (DE83-001120; DOE/ER-10558/3) Avail: NTIS HC A04/MF A01

A substantial improvement in optical efficiency over contemporary external reflector evacuated tube collectors has been achieved by integrating the reflector surface into the outer glass envelope. Described are the design fabrication and test results for a prototype collector based on this concept. A comprehensive test program to measure performance and operational characteristics of a 2 sq m panel (45 tubes) has been completed. Efficiencies above 50% relative to beam at 200 C have been repeatedly demonstrated. Both the instantaneous and long term average performance of this totally stationary solar collector are comparable to those for tracking line focus parabolic troughs. The yield, reliability and stability of performance achieved have been excellent. Subcomponent assemblies and fabrication procedures have been used which are expected to be compatible with high volume production. The collector has a wide variety of applications in the 100 to 300 C range including industrial process heat, air conditioning and Rankine engine operation. Author

N83-23894# Sandia Labs., Albuquerque, N. Mex
REPORTING OF OPERATIONAL RESULTS FROM INTERMEDIATE-SIZED PHOTOVOLTAIC SYSTEMS
 C. B. ROGERS, T. D. HARRISON, H. H. BAXTER, and H. D. PRUETT 1982 5 p refs Presented at the 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif., 28 Sep 1982
 (Contract DE-AC04-76DP-00789)
 (DE83-001273; SAND-82-2135C; CONF-820906-21) Avail: NTIS HC A02/MF A01

The performance of 12 intermediate sized photovoltaic power systems are evaluated. The data collection system and the monthly summary reports issued for each system are described. Typical data plots for an example system are presented. DOE

N83-23896# Lincoln Lab., Mass Inst. of Tech., Lexington
PROTOTYPE RESIDENTIAL PHOTOVOLTAIC SYSTEM: EVALUATION RESULTS
 B. E. NICHOLS and M. C. RUSSELL 1982 6 p refs Presented at the 16th IEEE PV Spec. Conf., San Diego, Calif., 27-30 Sep. 1982
 (Contract DE-AC02-76ET-20279)
 (DE83-001139; DOE/ET-20279/230; CONF-820906-12) Avail: NTIS HC A02/MF A01

Residential size photovoltaic power systems were discussed. Lessons learned from this experience, and performance summaries for the five prototype systems at the Northeast Residential Experiment Station and the system at the all electric Carlisle PV house are given. Results of evaluating five utility interactive residential size inverters also are reported. DOE

N83-23900# Sandia Labs., Albuquerque, N. Mex
LOW-COST MODULAR ARRAY-FIELD DESIGNS FOR FLAT-PANEL AND CONCENTRATOR PHOTOVOLTAIC SYSTEMS
 H. N. POST, D. C. CARMICHAEL (Battelle-Columbus Labs.), G. ALEXANDER (Battelle-Columbus Labs.), and J. A. CASTLE (Hughes Aircraft Co.) 1982 6 p refs Presented at the 16th IEEE Photovoltaics Spec. Conf., San Diego, Calif., 28 Sep. 1982
 (Contract DE-AC04-76DP-00789)
 (DE83-000079; SAND-82-0539C, CONF-820906-13) Avail: NTIS HC A02/MF A01

Described are the design and development of low-cost, modular array fields for flat-panel and concentrator photovoltaic (PV) systems. The objective of the work was to reduce substantially the cost of the array-field Balance-of-System (BOS) subsystems and site-specific design costs as compared to previous PV installations. These subsystems include site preparation, foundations, support structures, electrical wiring, grounding, lightning protection, electromagnetic interference considerations, and controls. To reduce these BOS and design costs, standardized modular (building-block) designs for flat-panel and concentrator array fields have been developed that are fully integrated and optimized for lowest life-cycle costs. Using drawings and specifications now available, these building-block designs can be used in multiples to install various size array fields. The developed designs are immediately applicable (1982) and reduce the array-field BOS costs to a fraction of previous costs. DOE

N83-23902# Sandia Labs., Albuquerque, N. Mex
DESIGN AND ECONOMICS OF A PHOTOVOLTAIC CONCENTRATOR ARRAY FOR OFF-GRID APPLICATIONS
 A. B. MAISH and M. RIOS, JR 1982 6 p refs Presented at the 16th IEEE Photovoltaics Spec. Conf., San Diego, Calif., 28 Sep. 1982
 (Contract DE-AC04-76DP-00789)
 (DE83-000318; SAND-82-2162C, CONF-820906-19) Avail: NTIS HC A02/MF A01

The array design and expected operation of a photovoltaic concentrator are discussed. A second generation stand alone 680 W/sub p/ photovoltaic (PV) concentrating array for low power, nongrid connected applications was designed. The array consists of six passive cooled point focus Fresnel lens concentrating modules on a two axis polar mount tracking structure. The new array design incorporates several major improvements to the first generation design. These include 50% more array area and a control system which allows unattended, fully automatic operation. The life cycle energy costs are calculated and compared to the equivalent energy costs of a 3 kW diesel electric generator set and an equivalent flat panel PV system. DOE

N83-23903# Sandia Labs., Albuquerque, N. Mex
SOME ADVANCED TESTING TECHNIQUES FOR CONCENTRATOR PHOTOVOLTAIC CELLS AND LENSES
 J. J. WICZER, R. J. CHAFFIN, and R. E. HIBRAY 1982 19 p refs Presented at 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif., 28 Sep. 1982
 (Contract DE-AC04-76DP-00789)
 (DE83-000321; SAND-82-2218C, CONF-820906-18) Avail: NTIS HC A02/MF A01

Two separate test techniques for evaluating concentrator photovoltaic components are described. A method was developed for measuring the entire illuminated I-V curve of a photovoltaic cell with a single flash of intense simulated sunlight. This method reduces the heat input to the cell and the time required to test a cell, allowing quick, indoor measurements of photovoltaic conversion efficiency at concentrated illumination levels. The other test method provides a technique to analyze the spatially dependent, spectral distribution of intense sunlight collected and focused by lenses designed for use in photovoltaic concentrator systems. The information is important in the design of multijunction photovoltaic receivers, secondary concentrators, and in optimizing the performance of conventional silicon cell concentrator systems. DOE

N83-23906# Sandia Labs., Albuquerque, N. Mex.
RESIDENTIAL PHOTOVOLTAIC SYSTEMS: RESULTS AND ISSUES

G. J. JONES and K. L. BIRINGER 1982 4 p refs Presented at 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif., 28 Sep. 1982

(Contract DE-AC04-76DP-00789)

(DE83-001032; SAND-82-2219C; CONF-820906-9) Avail. NTIS HC A02/MF A01

If the photovoltaic system in a residential application is viewed as dedicated to the household loads, the on site energy use becomes the key factor in system design. However, the basis for this viewpoint is that the backup electricity cost to the homeowner is independent of the PV system's presence. If a PV system reflects long term utility action, then the value of PV generated energy must be based on utility avoided cost independent of the point of energy use. This perspective is discussed and it is shown how it leads to a realization that residential system designs are independent of on site load and direct use fraction. DOE

N83-23907# Sandia Labs., Albuquerque, N. Mex.
FUTURE CONTINGENCIES AND PHOTOVOLTAIC SYSTEM WORTH

G. J. JONES, M. G. THOMAS, and G. J. BONK (General Electric Co., Schenectady, N.Y.) 1982 6 p refs Presented at the 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif., 28 Sep. 1982

(Contract DE-AC04-76DP-00789)

(DE83-001033; SAND-82-2220C; CONF-820906-8) Avail. NTIS HC A02/MF A01

The value of dispersed photovoltaic systems connected to the utility grid was calculated using the optimized generation planning program. The 1986 to 2001 time period was used for this study. Photovoltaic systems were dynamically integrated, up to 5% total capacity, into 9 NERC based regions under a range of future fuel and economic contingencies. Value was determined by the change in revenue requirements due to the photovoltaic additions. Displacement of high cost fuel was paramount to value, while capacity displacement was highly variable and dependent upon regional fuel mix.

N83-23908# Lincoln Lab., Mass. Inst. of Tech., Lexington.
REDUCTION OF PHOTOVOLTAIC CELL REVERSE BREAKDOWN BY A PERIPHERAL BYPASS DIODE

C. H. COX, III, D. J. SILVERSMITH, and R. W. MOUNTAIN 1982 6 p refs Presented at the 16th IEEE Photovoltaic Specialists Conf., San Diego, Calif., 28 Sep. 1982

(Contract DE-AC02-76ET-20279)

(DE83-001137; DOE/ET-20279/228; CONF-820906-6) Avail. NTIS HC A02/MF A01

A photovoltaic cell in a series connected string can be forced to operate in a power dissipation mode when the cell's short circuit current is reduced below the string current as a result of cracking or shadowing. New techniques for significantly reducing the power dissipated are reported based on locating protection for the cell around its periphery. One approach uses a standard diode, thereby requiring processing; the other approach uses a backward diode, which requires one additional doping step. A power dissipation reduction of more than a factor of 10 with the backward diode and over 30 for the standard diode. It is found that the standard diode requires a slight increase in cell interconnect complexity while the backward diodes uses conventional interconnection. DOE

N83-23920# Sandia Labs., Albuquerque, N. Mex. Solar Research and Evaluation Div.

MICROPROCESSOR-CONTROLLED SUNTRACKER AND LOAD CONTROLLER FOR PHOTOVOLTAIC CONCENTRATOR ARRAY POWER SYSTEMS

D. A. PRITCHARD 1982 9 p refs Presented at the 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif., 28 Sep. 1982

(Contract DE-AC04-76DP-00789)

(DE82-022163; SAND-82-2119C; CONF-820906-4) Avail. NTIS HC A02/MF A01

The design, development, and evaluation of a microcomputer based solar tracking and control system (TACS) for a photovoltaic (PV) concentrator array are described. The TACS combines the function of Sun tracking with the function of load adjustment for peak array efficiency. The complete PV array is used as the Sun sensor. The TACS minimizes tracking errors caused by dust and dirt on shadow band tracking systems, and minimizes the effects of structural warpage and sag that may occur in large arrays. A single board computer with a specially designed input/output board controls array positioning by an orderly method of stepped movements and finds the peak power point by scanning the current-voltage curve of the array. A deviation in maximum power of less than 1% during the day is shown. DOE

N83-23927# Helionetics, Inc., San Diego, Calif.

IMPROVED BEAM PROCESSING FOR TERRESTRIAL SOLAR CELLS

R. T. YOUNG, G. A. VANDERLEEDEN, R. D. WESTBROOK, R. L. SANDSTROM, and J. I. LEVATTER 1982 2 p refs Presented at the 16th IEEE Photovoltaics Spec. Conf., San Diego, Calif., 28 Sep. 1982

(Contract W-7405-ENG-26)

(DE82-022337; CONF-820906-3) Avail. NTIS HC A02/MF A01

The major difficulties at present in using laser beam processing for terrestrial solar cells are: (1) lack of a suitable laser for large volume cell production; and (2) expense and low throughput of conventional ion implantation, especially for the low energy implantation needed to obtain shallow p-n junctions. It is shown that these problems may be solved by simple glow discharge implantation equipment and an XeCl excimer laser for annealing. It is indicated that with this combination, p+n Si solar cells with efficiencies of 15% AM1 can be readily obtained without any back surface field. It is shown that the front surface metal coverage of the cells can be reduced to approximately 5% while retaining very good fill factors. The blue response of the cells is extremely good. DOE

N83-23929# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

THE SERI SOLAR-ENERGY-STORAGE PROGRAM IN FY 1982

W. LUFT Jul. 1982 6 p refs Presented at Energy Storage Contractors Rev. Meeting, Arlington, Va., 23 Aug. 1982

(Contract DE-AC02-77CH-00178)

(DE82-018306, SERI/TP-231-1660; CONF-820827-2) Avail. NTIS HC A02/MF A01

The SERI solar energy storage program in FY 1982 is summarized against the background of earlier years and the broader program of energy storage technology. The program provides research, system analyses, and assessments of thermal and thermochemical storage and transport, for thermal energy storage for solar thermal applications (TESSTA). Current activities include recommendations for the development of promising storage concepts for specified solar thermal power and process heat systems in house and subcontracted explorations of advanced concepts, and assessments of long distance solar thermal energy transport concepts. DOE

N83-23932# Energy Systems Group, Inc., Atlanta, Ga
ANALYSIS OF SELECTED PHOTOVOLTAIC SYSTEMS AND STORAGE OPTIONS FOR RESIDENTIAL APPLICATIONS IN HOT, HUMID CLIMATES

A. S. LAU, J. M. HILL, and D. E. BALL Aug. 1982 89 p refs
 (Contract DE-AC02-82CH-10122)
 (DE82-020531; DOE/CH-10122/3) Avail. NTIS HC A05/MF A01

The relationship is studied between photovoltaic (PV) generated power and its on-site use as a function of total array size for an energy-efficient house in the hot, humid climates of Miami and Houston. Options in addition to be the full-roof system using a direct current (dc) to alternating current (ac) inverter are studied in an effort to identify applications which are less expensive and which rely less on utility sellback. The results show that common residential loads in this climate lead to high on-site utilization. For the various PV applications studied, array sizes are identified which can be fully potential is identified both in the house structure and the domestic water heater. Using projected 1986 costs, the economics of selected systems were studied for Miami. Only one of the system sizes was found to be marginally competitive with utility supplied power. DOE

N83-23938# Department of Energy, New York Environmental Measurements Lab.

RADON AND RADON DAUGHTER MEASUREMENTS IN SOLAR ENERGY-CONSERVATION BUILDINGS

A. C. GEORGE, E. O. KNUTSON, and H. FRANKLIN Jul 1982 16 p refs
 (DE82-021874; DOE/EML-407) Avail. NTIS HC A02/MF A01

Measurements of radon and radon daughters in 11 buildings in five states, using active or passive solar heating showed no significant increase in concentration over the level measured in buildings with conventional heating systems. Radon concentrations were found to be normal levels. It appears that the slightly elevated indoor radon concentrations result from the local geological formations and from the tightening of the buildings rather than as a result of the solar heating technology. DOE

N83-23940# Sigma Research, Inc., Richland, Wash
DIRECT EXPANSION SOLAR COLLECTOR AND HEAT PUMP Final Report

May 1982 95 p refs
 (Contract DE-AC03-79SF-10542)
 (DE82-014662; DOE/SF-10542/T1) Avail. NTIS HC A05/MF A01

A hybrid heat pump/solar collector combination in which solar collectors replace the outside air heat exchanger found in conventional air-to-air heat pump systems is discussed. The solar panels ordinarily operate at or below ambient temperature, eliminating the need to install the collector panels in a glazed and insulated enclosure. The collectors simply consist of a flat plate with a centrally located tube running longitudinally. Solar energy absorbed by exposed panels directly vaporizes the refrigerant fluid. The resulting vapor is compressed to higher temperature and pressure, then, it is condensed to release the heat absorbed during the vaporization process. Control and monitoring of the demonstration system are addressed, and the tests conducted with the demonstration system are described. The entire heat pump system is modeled, including predicted performance and costs, and economic comparisons are made with conventional flat-plate collector systems. DOE

N83-23941# Energy Systems Group, Inc., Atlanta, Ga
ANALYSIS OF FIELD-TEST DATA FROM DOMESTIC SOLAR-WATER HEATERS IN THE SOUTHERN UNITED STATES, PERIOD THROUGH MAY 1982

W. M. JONES and R. A. JACOBS Aug 1982 95 p
 (Contract DE-AC02-82CH-10122A)
 (DE82-020532; DOE/CH-10122/2) Avail. NTIS HC A05/MF A01

Monitored performance data gathered from 103 solar water heaters are presented. All except 25 of the water heaters are

located in Florida. The locations and system types of the solar water heaters are tabulated. The annual energy saved, solar savings fraction, return on investment, and gallons per purchased energy are given for the systems. Analysis of the thermal performance data is discussed. The solar water heater sites are ranked according to various thermal performance values, and thermal performance data are plotted. Presented with the plots are the mean and standard error of the particular groupings of monitored data. Operational statuses causing performance interruptions are tabulated. DOE

N83-23950# Northrop Univ., Inglewood, Calif. Energy Research Center

THE POLARIS: A NEW TECHNOLOGY FOR LOW-COST SOLAR/GAS WATER HEATERS Final Report, Dec. 1980 - Feb. 1982

D. G. PELKA Feb. 1982 100 p refs
 (PB83-126060; GRI-81/10054) Avail. NTIS HC A05/MF A01
 CSCL 13A

A low-cost solar/gas augmented system (POLARIS) was designed, fabricated, and tested in prototype form. Based upon F-chart analysis, and when averaged over the U.S., this system would supply 48% of the annual heating load for a family of four. As part of this system, a new type of optical lens was fabricated which has major advantages over existing Fresnel lens systems. A new Freon driven tracking system was developed. This system tracked to within 1 degree accuracy and required no electric power for operation. In addition, modeling of various solar/gas interface scenarios was accomplished. These studies indicated that the most cost-effective overall system use occurred when an instantaneous point-of-use gas water heater was incorporated into the POLARIS system. Author (GRA)

N83-23952# Radiotechnique-Compelec, Caen (France) Industrial and Technical Div.

IMPROVEMENT IN THE PERFORMANCE OF SOLAR ENERGY PILES USING LARGE-DIAMETER SILICON MATERIAL Final Report

D. DIGUET Nov 1982 42 p Transl. into ENGLISH of the mono. "Amelioration des Performances de la Pile Solar au Silicium de Grand Diametre" (France), 1981 50 p
 (PB83-128686; EUR-7095-FR) Avail. NTIS HC A03/MF A01
 CSCL 10B

In an effort to reduce the cost of solar energy piles (generator/cell), comparative analyses were undertaken to show that improvements in the production of large diameter silicon material depend on the selection of ingots according to: (1) the oxygen concentration, for which a maximum level has been established, (2) the presence of lines of slip. In addition, a simplified process for the preparation of substrates was developed; studies were carried out on fully automatic surface treatment, the use of screen printing methods and materials to be applied to the system on contacts was investigated, and a process for welding connections was developed possessing a capacity of around 300 pieces/hour; automatic equipment was designed for the deposition of the anti-reflection bed. GRA

N83-24204# Sandia Labs., Albuquerque, N. Mex. Storage Batteries Div.

SOLSTOR II DESCRIPTION AND USER'S GUIDE

E. A. ARONSON, D. L. CASKEY, and K. D. MURPHY Jun 1982 140 p refs
 (Contract DE-AC04-76DP-00789)
 (DE83-000895; SAND-82-0188) Avail. NTIS HC A07/MF A01

Described is a FORTRAN 77 version of the SOLSTOR computer simulation code. The new code, SOLSTOR II, adds capabilities to the original SOLSTOR, which simulates photovoltaic (PV) systems, or wind energy conversion systems (WECS), with or without energy storage. SOLSTOR II allows both WECS and PV arrays to be considered simultaneously. SOLSTOR II minimizes the life cycle cost of providing energy by choosing the optimal solar and/or wind system component sizes. Back-up electricity may be provided either from a utility-grid connection or an on-site generator. In

utility connected systems both sell-back and time-of-day rates are considered
DOE

N83-24723# General Atomic Co., San Diego, Calif.
SOLAR PRODUCTION OF HYDROGEN USING THE SULFUR-IODINE THERMOCHEMICAL WATER-SPLITTING CYCLE Final Report

J. H. NORMAN, G. E. BESENBRUCH, and L. C. BROWN Oct. 1982 40 p refs
(Contract DE-AC01-80CS-80004)
(DE83-005828, GA-A16493) Avail: NTIS HC A03/MF A01

A sulfur-sulfuric acid energy storage system is proposed for the General Atomic Company (GA) sulfur-iodine thermochemical water splitting cycle. In this concept sulfur is burned to sulfur dioxide in air, generating the energy needed for the hydrogen production process at night and during periods of low insolation. The product of the sulfur burning reaction also provides one of the components (SO₂) of the main water splitting reaction. Sulfur is produced from SO₂ and water in a disproportionation reaction which also produces sulfuric acid. The SO₂ is produced by the solar thermal decomposition of sulfuric acid. The energetics of burning sulfur are a good match to the energy required for running the H₂ producing plant where 1 mole of S produces 1 mole of SO₂ which produces one mole of H₂. During useful insolation periods, the H₂ producing plant is operated directly from solar energy, H₂SO₄ is concentrated, and H₂SO₄ is thermally decomposed to SO₂, O₂, and H₂O. This scheme appears to have sufficient economic benefits that it is proposed to use this storage cycle seasonally.
DOE

N83-24881# Jet Propulsion Lab., California Inst. of Tech., Pasadena

THE 17TH AEROSPACE MECHANISMS SYMPOSIUM

May 1983 390 p refs Symp held in Pasadena, Calif., 5-6 May 1983, sponsored by NASA, California Inst. of Tech., and LMSC

(NASA-CP-2273; NAS 1 55:2273) Avail: NTIS HC A17/MF A01
CSCL 20K

The proceedings of the Aerospace Mechanisms Symposium are reported. Technological areas covered include space lubrication, aerodynamic devices, spacecraft/Shuttle latches, deployment, positioning, and pointing. Devices for spacecraft tether, magnetic bearing suspension, explosive welding, and a deployable/retractable mast are also described.

N83-25027# Crystal Systems, Inc., Salem, Mass
SILICON INGOT CASTING: HEAT EXCHANGE METHOD (HEM). MULTI-WIRE SLICING: FIXED ABRASIVE SLICING TECHNIQUE (FAST). PHASE 3 AND PHASE 4: SILICON SHEET GROWTH DEVELOPMENT FOR THE LARGE AREA SHEET TASK OF THE LOW-COST SOLAR ARRAY PROJECT Final Report, 15 Dec. 1978 - 30 Jun. 1981

F. SCHMID and C. P. KHATTAK Dec 1982 254 p refs
(Contract JPL-954373)

(NASA-CR-170213, JPL-9950-797, DOE/JPL-954373-81/19; NAS 1.26:170213; DRL-58-DRD-SE-7) Avail: NTIS HC A12/MF A01
CSCL 10A

Several areas of silicon sheet growth development are addressed including: silicon ingot casting, heat exchanger method, multiwire slicing, and fixed abrasive slicing technique.

N83-25028# Crystal Systems, Inc., Salem, Mass
PART 1: SILICON INGOT CASTING. HEAT EXCHANGER METHOD (HEM)

In its Silicon Ingot Casting, Phase 3 and Phase 4 111 p Dec. 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

Directional solidification by the Heat Exchanger Method (HEM) is a viable approach for directional solidification of silicon ingots used for terrestrial solar cell applications. Some of the significant advances made during this phase of the program were: ingot size, 34 cm x 34 cm x 17 cm - 45 kg, usable material yield - 90%, solar cell efficiency averaged over the whole ingot - 85% of

control CZ (35 kg ingot), very uniform resistivity over the boule, and cycle time for 36 kg ingots - 56 hours. Some of the problems encountered were growth rate decrease with increased ingot height, silicon carbide precipitates, and high dislocation density in HEM material. The silicon carbide is attributed to backstreaming of oil vapors from the vacuum pump; the high dislocation density is associated with the thermal history of the boule.
Author

N83-25029# Crystal Systems, Inc., Salem, Mass
PART 2: MULTI-WIRE SLICING. FIXED ABRASIVE SLICING TECHNIQUE (FAST)

In its Silicon Ingot Casting, Phase 3 and Phase 4 67 p Dec. 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

The Fixed Abrasive Slicing Techniques (FAST) is a new slicing technique that was developed to slice ingots more effectively. It was demonstrated that 25 wafers/cm can be sliced from 10 cm diameter and 19 wafers/cm from 15 cm diameter ingots. Over 99% yield (222 out of a possible 224) was demonstrated during slicing of a 10 cm diameter ingots at 25 wafers/cm. The average thickness of wafers was 0.249 mm and the kerf was 0.151 mm. Slicing rates as high as 0.14 mm/min were also demonstrated for 10 cm diameter ingots.
Author

N83-25031# Crystal Systems, Inc., Salem, Mass.

SILICON CRYSTAL GROWTH IN VACUUM

C. P. KHATTAK and F. SCHMID *In its* Silicon Ingot Casting, Phase 3 and Phase 4 4 p Dec. 1982

Avail: NTIS HC A12/MF A01 CSCL 10A

The most developed process for silicon crystal growth is the Czochralski (CZ) method which was in production for over two decades. In an effort to reduce cost of single crystal silicon for photovoltaic applications, a directional solidification technique, Heat Exchanger Method (HEM), was adapted. Materials used in HEM and CZ furnaces are quite similar (heaters, crucibles, insulation, etc.). To eliminate the cost of high purity argon, it was intended to use vacuum operation in HEM. Two of the major problems encountered in vacuum processing of silicon are crucible decomposition and silicon carbide formation in the melt.
Author

N83-25033# Crystal Systems, Inc., Salem, Mass
SINGLE CRYSTAL GROWTH OF UPGRADED METALLURGICAL SILICON BY HEM FOR PHOTOVOLTAIC APPLICATIONS

C. P. KHATTAK, F. SCHMID, and L. P. HUNT (Dow Corning Corp., Hemlock, Mich.) *In its* Silicon Ingot Casting, Phase 3 and Phase 4 12 p Dec 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

Commercially available metallurgical grade (MG) silicon has high B and P content which is not reduced significantly by directional solidification. By choosing high purity raw materials for an experimental Submerged Electrode Arc Furnace, most of the impurities are reduced to 10 ppmw. Directional solidification of upgraded metallurgical grade (UMG) silicon by the Heat Exchanger Method (HEM) has produced 16 cm x 16 cm cross section ingots with nearly single crystal structure. The main problem encountered during directional solidification was SiC impurities dispersed through the structure. Solar cells fabricated from UMG silicon that was directionally solidified twice by HEM have shown up to 12.33% (am1) conversion efficiency.
Author

N83-25040# Honeywell Systems and Research Center, Minneapolis, Minn.

SPECTROPHOTOVOLTAIC ORBITAL POWER GENERATION Final Report, Aug. 1981 - Nov. 1982

G. KNOWLES and J. CARROLL 31 Mar. 1983 82 p refs

(Contract NAS8-22511)

(NASA-CR-170754; NAS 1.26:170754; HONEYWELL-83SRC22)

Avail: NTIS HC A05/MF A01 CSCL 10B

A subscale model of a photovoltaic power system employing spectral splitting and 1000:1 concentration was fabricated and tested. The 10-in. aperture model demonstrated 15.5% efficiency with 86% of the energy produced by a GaAs solar cell and 14% of the energy produced by an Si cell. The calculated efficiency of

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the system using the same solar cells, but having perfect optics, would be approximately 20%. The model design, component measurements, test results, and mathematical model are presented
Author

N83-25041*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

DOE AND AID STAND-ALONE PHOTOVOLTAIC ACTIVITIES

W. J. BIFANO and A. F. RATAJCZAK 1983 9 p refs Presented at the Ann. Meeting of the Am. Solar Energy Soc., Minneapolis, 1-3 Jun 1983

(Contract DE-AI01-79ET-20485)

(NASA-TM-83374, E-1642, NAS 1.15 83374;

DOE/NASA/20485-15) Avail: NTIS HC A02/MF A01 CSCI 10A

The NASA Lewis Research Center (LeRC) is managing stand-alone photovoltaic (PV) system activities sponsored by the U.S. Department of Energy (DOE) and the U.S. Agency for International Development (AID). The DOE project includes village PV power demonstration projects in Gabon (four sites) and the Marshall Islands, PV-powered medical refrigerators in six countries, PV system microprocessor control development activities and PV-hybrid system assessments. The AID project includes a large village system in Tunisia, a water pumping/grain grinding project in Upper Volta, five medical clinics in four countries, PV-powered remote earth station application. These PV activities and summarizes significant findings to data are reviewed.
Author

N83-25052# Solar Economics, Inc., Dallas, Tex
ECONOMIC AND FINANCIAL ANALYSIS OF RESIDENTIAL PHOTOVOLTAIC SYSTEMS. THE IMPACT OF SOLAR PHOTOVOLTAICS ON UTILITIES Final Report

M. T. KATZMAN and A. C. KATZMAN Feb 1982 33 p refs

(Contract DE-AC02-76ET-20279)

(DOE/ET-20279/185) Avail: NTIS HC A03/MF A01

Hourly load data from El Paso Electric and Boston Edison are subjected to preliminary examination by comparison with simulated photovoltaic array output. Three utility production costing and reliability models are compared: SYSGEN, SIMSTOR, and GENCO. All simulations suggest that photovoltaic penetration will: (1) result in economically significant fuel savings, (2) result in small reductions in capacity requirements; (3) result in total savings that are likely to exceed the costs of photovoltaic systems by the late 1980s. The value of savings per MW of photovoltaics diminishes with increased penetration.
Author

N83-25053# Spire Corp., Bedford, Mass
DESIGN AND FABRICATION OF AIR- AND LIQUID-COOLED PHOTOVOLTAIC/THERMAL COLLECTORS

M. J. NOWLAN Sep 1981 59 p refs

(Contract DE-AC02-76ET-20279)

(DOE/ET-20279/162) Avail: NTIS HC A04/MF A01

A liquid type photovoltaic/thermal collector and a photovoltaic cell panel for an air type photovoltaic/thermal collector were constructed. The development of residential photovoltaic/thermal collectors was pursued as an alternative to side by side photovoltaic module and thermal collector systems for applications with high heating loads and limited roof area. The units were designed to demonstrate the feasibility of high performance photovoltaic/thermal units
S L

N83-25054# New Mexico State Univ., Las Cruces Solar Energy Inst.

DATA REPORT FOR THE SOUTHWEST RESIDENTIAL EXPERIMENT STATION, DECEMBER 1981

M. LIEBERMAN, O. Y. HAI, G. HOCKING, and C. WHITAKER 29 Jan 1982 22 p

(Contract DE-AC02-76ET-20279)

(DOE/ET-20279/184) Avail: NTIS HC A02/MF A01

The Residential Experiment Stations of the Solar Photovoltaic Residential Project were designed to develop residential photovoltaic systems and to gather and disseminate performance

data. Physical performance data obtained from the photovoltaic energy systems under test are tabulated.
S L

N83-25076# Aerospace Corp., Germantown, Md.

ASSESSMENT OF ENERGY STORAGE FOR SOLAR APPLICATIONS

D. J. EDWARDS and S. ROSENZWEIG /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 194-200 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

The first three phases of the Solar Applications Analysis for Energy Storage study performed for the Office of Advanced Conservation Technologies of the Department of Energy is presented. Phase 1 surveyed solar energy applications, phase 2 developed a uniform methodology for assessments, and phase 3 summarized prior applicable storage assessments. Three referenced reports thoroughly cover each of the phases and are available from the authors.
Author

N83-25078# Argonne National Lab., Ill.

DEVELOPMENT OF NATURAL STRATIFICATION TECHNOLOGY

R. L. COLE and F. O. BELLINGER /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 224-230 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

The development of natural stratification of water in sensible heat storage tanks is studied, and comparisons of experimental data with diffusion theory equations are made. A simple 1-D model of stratification that gives a good results is presented and verified with measured tank performance. A stratification index is introduced that allows a rapid comparison to be made of tank performance data. A semi-empirical equation is given that will allow a prediction to be made regarding the tank operating performance providing that an empirical constant related to the mixing heights may be evaluated. A method to estimate a value for the constant is given for the case of a tank with a side inlet and outlet. Implications of stratification in regard to overall system control strategy are discussed. The goal is to provide system designers with the guidelines necessary to assure the establishment and maintenance of stratification and to take advantage of it.
Author

N83-25080# Rocket Research Corp., Redmond, Wash.

APPLICATION OF THERMAL ENERGY STORAGE TO PROCESS HEAT RECOVERY. PHASE 3: HEAT EXCHANGER EVALUATION

L. B. KATTER /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 246-248 Feb 1982

Avail: NTIS HC A17/MF A01

The use of thermal energy storage to improve the utilization of reject process heat as a source of energy for a district heating system was investigated. The specific energy source studied is the aluminum reduction process. The energy supply in an aluminum plant is continuous and constant, 24 hours per day, 365 days per year. The energy demand in a district heating system is highly cyclical, on a diurnal basis, an annual basis, and a third cyclical variation in demand is found in the weekly use patterns. Thermal energy storage improves the cost-effectiveness of investments in energy recovery and distribution equipment and decreases the need for supplemental fuel for the district heating system.
Author

N83-25083# Martin Marietta Aerospace, Denver, Colo

MOLTEN SALT THERMAL ENERGY STORAGE SUBSYSTEM FOR SOLAR THERMAL CENTRAL RECEIVER PLANTS

P. B. WELLS and G. P. NASSOPOULOS (American Technigaz, Inc., Hingham, Mass.) /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 279-285 Feb. 1982

Avail: NTIS HC A17/MF A01

The development of a low cost thermal energy storage subsystem for large solar plants is described. Molten nitrate salt

is used as both the solar plant working fluid and the storage medium. The storage system consists of a specially designed hot tank to hold salt at a storage temperature of 839K (1050 deg F) and a separate carbon steel cold tank to hold the salt after its thermal energy has been extracted to generate steam. The hot tank is lined with insulating firebrick to reduce the shell temperature to 561K (550 deg F) so that a low cost carbon steel shell is used. The internal insulation is protected from the hot salt by a unique metal liner with orthogonal corrugations to allow for numerous cycles of thermal expansion and contraction. A preliminary design for a large commercial size plant (1200 MWh sub +), a laboratory test program for the critical components, and the design, construction, and test of a small scale (7 MWh sub t) research experiment at the Central Receiver Test Facility in Albuquerque, New Mexico is described. Author

N83-25086# Babcock and Wilcox Co., Lynchburg, Va. Advanced Energy Systems.

CONCEPTUAL DESIGN OF THE MOVING BED THERMAL ENERGY STORAGE SYSTEM FOR A COMMERCIAL SCALE (100 MWE) SOLAR CENTRAL RECEIVER POWER PLANT

R. L. WRIGHT, T. P. SUCHOCKI, and D. C. SCHLUDERBERG /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 309-316 Feb. 1982 refs Avail. NTIS HC A17/MF A01

A conceptual design was developed for an advanced thermal energy storage system which is applicable to a 100 MWe solar central receiver plant using water/steam as the working fluid. Operating conditions studied were 510C/10.1 MPa from the receiver and 299C/2.72 MPa from storage. The concept offers potential for cost and performance improvements over the oil/rock concept which is installed at the central receiver 10 MWe pilot plant under construction. The moving bed thermal energy storage system (MBTESS) uses a free flowing refractory material as the heat transport and storage media. Cost and performance, are estimated. E.A.K.

N83-25087# Combustion Engineering, Inc., Windsor, Conn. Advanced Development Dept.

CONCEPTUAL DESIGN OF A LATENT HEAT THERMAL ENERGY STORAGE SUBSYSTEM FOR A SATURATED STEAM SOLAR RECEIVER AND LOAD

G. F. DILAURO and R. E. RICE (Comstock and Wescott, Inc., Cambridge, Mass.) /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 318-322 Feb 1982 refs Avail. NTIS HC A17/MF A01

The conceptual design of a tube intensive latent heat thermal energy storage (TES) subsystem which utilized a eutectic mixture of sodium hydroxide and sodium nitrate as the phase change material (PCM) was developed. The charging and discharging of the unit is accomplished by the same serpentine tube bundle heat exchanger in which heat transfer is augmented by aluminum channels acting as fins. Every tenth channel is made of steel to provide tube support. E.A.K.

N83-25089# AirResearch Mfg. Co., Torrance, Calif. **APPLICATION OF BUFFER THERMAL ENERGY STORAGE TO AN AIR BRAYTON SOLAR ENGINE**

H. J. STRUMPF and K. P. BARR /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 341-349 Feb. 1982 refs Avail. NTIS HC A17/MF A01

The application of latent heat buffer thermal energy (TES) storage to a point focusing solar receiver equipped with an air Brayton engine is discussed. The 85-kw(th) Air Brayton Solar Receiver (ABSR) and Mod 'O' engine were used as a baseline system. The operating life of a Brayton engine depends, in general, upon the number of start-stop cycles. The main advantage of buffer thermal energy storage is that it enables the engine to continue running during periods of cloud cover, thus reducing the number of engine shutdowns and increasing engine life. To demonstrate the effect of buffer thermal energy storage on engine

operation, a computer program was written for complete transient/steady/state Brayton cycle performance. The solar insolation input was minute by minute data. The results indicated that thermal storage can afford a significant decrease in the number of engine shutdowns as compared to operating without thermal storage. It was also found that the number of shutdowns does not continuously decrease as the storage material weight increases. In fact, there appears to be an optimum weight for minimizing the number of shutdowns. It was also indicated that the economic viability of buffer thermal energy storage is largely a function of the achievable engine life. At low predicted life, thermal storage is economically attractive, for highly reliable, long lived engines, thermal storage is not economical. S.L.

N83-25092# Washington Univ., Seattle Aerospace and Energetics Research Program.

HIGH TEMPERATURE INTEGRATED THERMAL STORAGE FOR SOLAR THERMAL APPLICATIONS

A. P. BRUCKNER, A. HERTZBERG, and R. T. TAUSSIG (Mathematical Sciences Northwest, Bellevue, Wash.) /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 384-389 Feb 1982 refs Avail. NTIS HC A17/MF A01

A high temperature (1500 to 2000 K) heat transfer and storage system for solar thermal applications is described. A silica glass in bead form is melted in a solar receiver and stored in a large, refractory lined vessel. The molten glass is available for later discharge in a direct contact droplet heat exchanger, where a working gas is heated and solid glass beads are formed for recycle. The very low cost of the storage material makes the energy related unit capital cost of this storage system an order of magnitude lower than that of the nearest competing concept. S.L.

N83-25093# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

COMMERCIAL PHOTOVOLTAICS MEASUREMENTS WORKSHOP PROCEEDINGS

H. A. SCHAFFT, ed. (NBS, Washington, D.C.) and S. HOGAN, ed. 1981 294 p refs Workshop held in Vail, Colo., 27-29 Jul 1981 (SERI/CP-214-1403) Avail. NTIS HC A13/MF A01

Measurements equipment needs, interaction with customer, source for reference cells, cell and module output measurements, quality assurance, silicon materials characterization, solar irradiance data, and photovoltaic module certification are discussed.

N83-25110# Pacific Northwest Lab., Richland, Wash. Electro-Optic Systems

SPECTRAL RESPONSE MEASUREMENTS FOR SOLAR CELLS

J. S. HARTMAN and M. A. LIND /in Midwest Research Inst. Com. Photovoltaics Meas. Workshop Proc. p 235-242 1981 refs Avail. NTIS HC A13/MF A01

Spectral response measurements, measurement systems, and potential measurement problems relative to the characterization of solar cells are presented. Measurement systems are outlined for determining the spectral response, external quantum efficiency, and internal quantum efficiency of solar cells. Practical system components and measurement systems are presented along with their potential advantages and weaknesses. Several solar cell properties which must be considered before a measurement system can be designed to evaluate a specific type of solar cell are discussed. E.A.K.

N83-25123# Stevens Point Area Co-op, Wis. **PASSIVE-SOLAR COLLECTOR: A TROMBE-WALL RETROFIT GUIDE**

T. BROWN and M. DOSTAL 1982 35 p refs (Contract DE-FG02-80R5-10252, DE-FG02-81R5-10333) (DE83-005189; DOE/R5-10333/3) Avail. NTIS HC A03/MF A01

Step by step instructions are given for converting existing south facing masonry walls into Trombe walls. Locally available materials

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are used for the most part and minimal carpentry skills are required. Some design variations and modifications are suggested. Performance monitoring and operation and maintenance are discussed. Costs are estimated. A way is given to estimate energy savings. DOE

N83-25128# Stilson (Alden E.) and Associates, Columbus, Ohio.

ROTATING FIELD COLLECTOR SUBSYSTEM PHASE 1 STUDY AND EVALUATION

D JONES and J A EIBLING Oct. 1982 145 p refs
(Contract DE-AC04-76DP-00789, SNLL-84-1986)
(DE83-003316, SAND-82-8184) Avail: NTIS HC A07/MF A01

The rotating field collector system is an alternative concept in which all heliostats are mounted on a single large platform which rotates around a tower to track the azimuthal angle of the Sun. Each heliostat is mounted to the platform with appropriate pivots, linkage, and controls to provide the additional positioning required to properly direct the solar radiation onto the receiver. The results are presented of the first phase of a study to investigate the technical and economic merits of a particular type of rotating field collector subsystem. The large pie-shaped platform would revolve over an array of support pedestals by means of a roller at the top of each pedestal. Several heliostats were built to demonstrate their construction features, and the operation of both flat and amphitheater rotating fields was studied. Work included an analysis of the concepts, development of modifications and additions to make the system comply with design criteria, and cost estimates to be used for comparison with other heliostat subsystems. Because of considerably high cost estimates, the focus of a large part of the study was directed toward developing lower cost designs of major components. DOE

N83-25129# Los Alamos Scientific Lab, N. Mex.

LOS ALAMOS PASSIVE TEST CELL RESULTS FOR THE 1981-82 WINTER

R. D. MCFARLAND, J. C. HEDSTROM, J. D. BALCOMB, and S. W. MOORE Oct 1982 54 p refs
(Contract W-7405-ENG-36)
(DE83-002948; LA-9543-MS) Avail: NTIS HC A04/MF A01

The Los Alamos test cell operation during the winter of 1981-82 including comparisons with the 1980-81 winter is discussed. Extensive data were taken and computer-analyzed to determine performance parameters such as efficiency, solar savings fraction, and discomfort index. The data from different test cells are directly comparable because each has similar heating-load coefficient and collector area. Configurations include direct gain, unvented Trombe walls, water wall, phase-change wall, and sunspaces. Strategies for reducing heat loss include selective surfaces, two types of improved glazing systems, a heat pipe system, and convection suppression baffles. Significant difference in both auxiliary heat and comfort were observed among the various system types. The results are useful, not only for direct system comparisons, but also to provide data for validation of computer simulation programs. Availability of hourly data is described. DOE

N83-25130# Boeing Computer Services, Inc., Seattle, Wash. INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT FOR NEWMAN POWER STATION, EL PASO, TEXAS, VOLUME 14 Report, Jul. - Aug. 1982

Jan. 1983 40 p
(Contract DE-AC04-76DP-00789)
(DE83-005377, SAND-81-7086/14) Avail: NTIS HC A03/MF A01

Presented are the data accumulated during July and August at the intermediate photovoltaic project at Newman Power Station, El Paso, Texas. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-25142# Sandia Labs, Albuquerque, N. Mex. Thermal Test and Analysis Div

RESULTS OF SOLAR TESTING OF CIRCULAR FOIL HEAT-FLUX SENSORS AT THE WHITE SANDS SOLAR FURNACE

B. L. BAINBRIDGE 1982 27 p Presented at the STTFUA High-Intensity Solar Flux Meas. Tech. Workshop, Albuquerque, N. Mex., 26 Oct 1982
(Contract DE-AC04-76DP-00789)
(DE82-006282; SAND-81-2390C, CONF-821001-1) Avail: NTIS HC A03/MF A01

A pair of circular foil heat flux sensors were tested against a Kendall radiometer. The gages are a form of the circular foil type in that a mirrored ellipsoidal cavity is positioned in front of the foil surface. A small diameter aperture is used to reduce convective losses and the susceptibility of the gage to handling damage. An error analysis performed on the data acquired during the five day test program, indicates that atmospheric conditions and limitations of the facility preclude the accurate comparison of the heat flux sensors to the Kendall radiometer. Details about the data acquisition, error analysis, and consideration about the proper gage calibration procedure are included. DOE

N83-25143# Los Alamos Scientific Lab, N. Mex.

LOS ALAMOS NATIONAL LABORATORY SOLAR PROGRAM

S. K. REISFELD and D. A. NEEPER 1982 13 p refs Presented at the Passive and Hybrid Solar Energy Update Conf., Washington, 15-17 Sep. 1982
(Contract W-7405-ENG-36)
(DE82-021760, LA-UR-82-2496; CONF-820940-2) Avail: NTIS HC A02/MF A01

Progress for passive solar tasks is reported. Results on test cell experiments for the 1981-1982 winter, class-A performance monitoring, passive cooling, both residential and commercial economic cooling assessments, and thermal effects of distributed mass in passive buildings are presented. EAK

N83-25167# Boeing Computer Services, Inc., Seattle, Wash.

INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 6: FOR OKLAHOMA CENTER FOR SCIENCE AND ARTS, OKLAHOMA CITY, OKLAHOMA, OCTOBER 1982

Dec 1982 26 p
(Contract DE-AC04-76DP-00789)
(DE83-005489; SAND-81-7087/6) Avail: NTIS HC A03/MF A01

Presented are the data accumulated during October 1982 at the intermediate photovoltaic project at Oklahoma Center for Science and Arts, Oklahoma City, Oklahoma. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-25168# Sandia Labs, Albuquerque, N. Mex. Solar Energy Dept

SHENANDOAH SOLAR TOTAL-ENERGY PROJECT

J. A. LEONARD and R. W. HUNKE Dec 1982 10 p
(Contract DE-AC04-76DP-00789)
(DE83-005244; SAND-80-2560) Avail: NTIS HC A02/MF A01

The design and construction of the world's first solar total energy plant in the private sector was completed and checkout is underway. During its operational phase, the solar plant will furnish electrical power, process steam, and other thermal energy to a nearby knitwear factory. The solar system consists of a collector field containing 114 parabolic dish collectors which supply thermal energy at 4000 C to drive a 400 kW multistage Rankine cycle turbine generator. Some steam is extracted from the turbine and supplied to the knitwear manufacturing processes. The system will be grid connected. Presented are a description of the system and components being installed, a summary of performance testing of the extraction turbine and of four prototype parabolic dish collectors, and a discussion of design considerations and insights which have general applicability to solar thermal system designs. DOE

N83-25169# Lincoln Lab., Mass. Inst. of Tech., Lexington.
POWER PROCESSING SUBSYSTEMS FOR THE 100-KWP SOLAR-PHOTOVOLTAIC-POWER SYSTEM AT THE NATURAL BRIDGES NATIONAL MONUMENT IN UTAH
 F. J. SOLMAN and S. D. COLEMAN 30 Jun 1982 201 p
 (Contract DE-AC02-76ET-20279)
 (DE83-005246; DOE/ET-20279/180-VOL-5) Avail: NTIS HC A10/MF A01

The power processing subsystem for the Natural Bridges National Monument photovoltaic power system including inverters, battery chargers, battery, diesel generator, site transfer switch, transformer in-rush controller, furnace loads, and load control equipment are described. Components and subsystem testing are also discussed. Also included are the solution to operational problems. DOE

N83-25170# Stevens Point Area Co-op, Wis
COOPERATIVE PASSIVE-SOLAR COMMERCIAL RETROFIT Final Report, 1 Sep. 1980 - 31 Dec. 1982
 W. T. BROWN Dec. 1982 14 p
 (Contract DE-FG02-80RS-10252)
 (DE83-005269; DOE/R5-10252/2) Avail: NTIS HC A02/MF A01

The primary objectives of this project were: the conversion of an existing south-facing storefront into a trombe'-wall passive solar collector, the sharing of information on simple low-cost energy alternatives with the local community, and the reduction of the store building's dependence on non-renewable fossil fuel for space heating. Six 6' wide pre-assembled collector glazing panels were mounted on a 12' high by 36' long portion of the south-facing masonry wall. Vent-holes were cut through the wall at each panel to provide air inlets and outlets for the collector and monitoring equipment was installed to record performance. A series of hands-on construction workshops were attended by Co-op and community members. During these sessions, collector components were assembled. The panels were installed on April 22, 1981 in celebration of Earth Day. Additional sessions were held to complete the project, make necessary modifications and install sensors. Project personnel participated in several energy-education activities, including workshops, seminars and alternative energy home tours. A community-based energy resource council was founded with the assistance of several key Co-op project members and a fully-illustrated How-To manual, entitled Passive Solar Collector A Trombe'-Wall Retrofit Guide was published. Finally, a variety of energy conservation measures were undertaken. These included a new airlock store entry, insulated store ceiling, destratification ceiling fans and wood-burning furnaces have combined with the passive solar collector to substantially reduce the use of fuel oil for heat. DOE

N83-25171# Sandia Labs., Albuquerque, N. Mex. Solar Research and Evaluation Div
DEVELOPMENT OF A SOLAR-FLUX TRACKER FOR PARABOLIC-TROUGH COLLECTORS
 K. D. BOULTINGHOUSE Sep. 1982 33 p refs
 (Contract DE-AC04-76DP-00789)
 (DE83-005361; SAND-82-1600) Avail: NTIS HC A03/MF A01

The development of a solar flux tracker for application to a parabolic trough solar thermal collector is described. Tests were conducted at the Collector Module Test Facility and Performance Prototype Trough Test Facility on a resistance wire type solar flux sensor. The device consists of two fine wires installed along each side of the absorber tube parallel to the axis. The wires change resistance as a function of the solar flux arriving at the absorber from the reflectors. The resistance of the two wires is compared to produce a null signal when both wires are equally illuminated. The signal from the wires is used in combination with a microprocessor control system to drive the collectors to the optimum tracking angle. Comparisons are made between the performance of the flux tracker, a computer based tracker, and a shadow band tracker. DOE

N83-25172# General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div.
INITIAL DETAILED DESIGNS FOR INTERMEDIATE PHOTOVOLTAIC SYSTEMS: OFFICE BUILDING
 J. HERZ and G. OBRIEN Jul. 1982 198 p refs
 (Contract DE-AC04-76DP-00789)
 (DE83-005365; SAND-81-7188) Avail: NTIS HC A09/MF A01

A detailed design is presented for a 140 kW ground mounted flat plate array photovoltaic system to serve a three story office building. The design is analyzed for performance and economics. Building architectural features and load demands are defined. Photovoltaic array, electrical system design, and system installation are discussed, along with alternative design choices. Specifications and installation details are included. DOE

N83-25176# Edgerton, Germeshausen and Grier, Inc., Albuquerque, N. Mex. Energy Measurements Group.
PERFORMANCE TESTING OF THE SOLAR KINETICS T-700A SOLAR COLLECTOR
 V. E. DUDLEY and R. M. WORKHOVEN (Sandia National Lab) Nov. 1982 85 p refs
 (Contract DE-AC04-76DP-00789)
 (DE83-005382; SAND-81-0984) Avail: NTIS HC A05/MF A01

Results are summarized of tests conducted on a Solar Kinetics T-700A solar collector which is a parabolic trough collector. The collector was evaluated with a glass mirror and with an acrylic film-reflector surface. Tests were conducted over a temperature range from 200 to 3600 C, using three heat-transfer fluids and absorber tubes of two different diameters. Tests were also made with direct normal solar irradiance from 200 to 1050 W/m(2). Collector efficiency and thermal loss were found to change significantly with changes in solar irradiance. Using only a measured efficiency curve, a thermal loss curve, and a measurement of the approximate optical efficiency, a procedure was developed to predict the collector efficiency and thermal loss at any level of solar irradiance and for any temperature within the range of test data. DOE

N83-25178# Midwest Research Inst., Golden, Colo. Renewable Resource Assessment and Instrumentation Branch.
CATALOG OF AUTOMATIC SUN-FOLLOWING TRACKERS
 T. L. STOFFEL Nov 1982 127 p refs
 (Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
 (DE83-005529; SERI/TR-215-1490) Avail: NTIS HC A07/MF A01

Instrument platforms required for monitoring the solar radiation resources, controlling the alignment of solar collectors, and a variety of research applications where accurate and continuous alignment with the Sun is important are investigated. The development status and availability of automatic Sun-following trackers are assessed. DOE

N83-25189# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 8: FOR LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO
 Feb 1982 27 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-012060; SAND-81-7085/8-VOL-8) Avail: NTIS HC A03/MF A01

For the month of January, 1982, performance data are given for a grid-connected photovoltaic power supply at a New Mexico shopping center. Data presented include: daily and monthly energy produced; daily and monthly incident solar energy; daily and monthly array efficiency; plots of energy produced as a function of power level, voltage, cell temperature, and hour of the day; power conditioner input, output and efficiency for two individual units and for the total power conditioning system; daily and monthly photovoltaic energy supplied to the load and the corresponding dollar value for the month; photovoltaic system efficiency; capacity factor; daily system availability; daily and hourly insolation; daily and hourly ambient temperature; daily and hourly wind speed, wind

direction distribution, heating and cooling degree days, number of freeze/thaw cycles, hourly cell temperature; daily data acquisition mode and recording interval plot. Also included are brief summaries of three operations-related events. DOE

N83-25190# Sandia Labs., Albuquerque, N. Mex.
DYNAMIC BEHAVIOR OF A CLASS OF PHOTOVOLTAIC CONVERTERS

O. WASYN CZUK 1982 30 p refs Presented at IEEE Power Engr. Soc. Winter Meeting, New York, 30 Jan. 1982 (Contract DE-AC04-76DP-00789) (DE82-019344; SAND-82-7075C; CONF-820134-2) Avail: NTIS HC A03/MF A01

The dynamic behavior of a specific photovoltaic design which utilizes the perturb and observe method of peak power tracking is discussed. It is shown that when the insolation does not vary with time, the perturb and observe method is able to converge to peak power conditions; however, when the insolation varies randomly at any substantial rate, the perturb and observe method fails to adequately track the peak power conditions. An alternate method of power tracking which utilizes the harmonic component of the array voltage and current to establish proper control action is examined. The performance of this method as compared to the perturb and observe method is demonstrated using a detailed hybrid simulation of the photovoltaic system. The design of the photovoltaic system and the detailed simulation of the various system components are described. DOE

N83-25191# Westinghouse Research and Development Center, Pittsburgh, Pa. Research and Development Center.

DEVELOPMENT OF COPPER SULFIDE/CADMIUM SULFIDE THIN-FILM SOLAR CELLS Technical Progress Report, 1 Apr. - 30 Jun. 1981

J. R. SZEDON, W. J. BITER, and H. C. DICKEY 8 Mar. 1982 31 p refs (Contract DE-AC022-77CH-00178) (DE82-013339, SERI/PR-8143-1-T7, TPR-8) Avail: NTIS HC A03/MF A01

The complex effects that occur during the aging of Cu₂S/CdS thin film solar cells in flowing wet oxygen were demonstrated. At constant illumination, the short circuit current of cells aged at room temperature consistently decreases with time. The second effect, related to diode opposing current, result from several competing mechanisms. Over the short term, the magnitude of diode opposing current decreases. After approx. 20 hours of aging, opposing current generally returns to the level achieved after hydrogen annealing which immediately preceded the aging sequence. There is no significant change in Cu₂S transmission behavior for wavelengths ranging from 525 to 1000 nm during wet-oxygen aging for periods of 2 to 36 hours. The CdS grain structure details in the junction detector area is compared to an adjacent metallized area. DOE

N83-25192# Sandia Labs., Albuquerque, N. Mex.
DEPARTMENT OF ENERGY SOLAR-CENTRAL-RECEIVER ANNUAL MEETING

Feb. 1982 297 p Meeting held in Claremont, Calif., 13 Oct. 1981 (Contract DE-AC04-76DP-00789) (DE82-011932; SAND-82-8002; CONF-8110176) Avail: NTIS HC A13/MF A01

Topics on solar energy central receivers were discussed. Discussions included sections on systems and component development. Also included is a list of Central Receiver Test Facility projects. DOE

N83-25194# Sandia Labs., Albuquerque, N. Mex.
ADVANCED CONCENTRATOR CELL RESEARCH AT SANDIA NATIONAL LABORATORIES

J. WICZER 1982 13 p Presented at the 8th Photovoltaic Concentrator Project Integration Meeting, Albuquerque, N. Mex., 27 Jan. 1982 (Contract DE-AC04-76DP-00789) (DE82-005772, SAND-82-0224C; CONF-820114-1) Avail: NTIS HC A02/MF A01

During the past five years, Sandia National Laboratories in conjunction with the US Department of Energy has supported several research projects for advanced single junction and multijunction concentrator solar cells in compound semiconductor materials. These research projects have received over 3.5 million dollars in government support during this period. A brief review of the major, Sandia supported compound semiconductor cell development programs is presented. Highlights of these programs are outlined with some observations on current research efforts. In addition, a brief overview is presented on some diagnostic techniques recently developed at Sandia in support of these programs. A discussion of the recently completed lens analyzer for the study of chromatic aberrations in concentrator Fresnel lenses is included. DOE

N83-25195# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR CATHEDRAL SQUARE 10-STORY APARTMENT BUILDING, BURLINGTON, VERMONT

D. BEERS 15 Jan. 1982 66 p (Contract DE-AB01-76CS-31020) (DE82-010058, SOLAR/1060-82/50) Avail: NTIS HC A04/MF A01

A system is described for preheating domestic hot water (DHW) for a 10-story Vermont apartment building. The system consists of 2012 square feet of roof-mounted flat plate collectors, a 3000 gallon storage tank, a water-glycerol solution for heat collection and transfer, and a natural gas-fired hot boiler for auxiliary heating. The total system is described and diagrammed, and the design of the collector, storage, energy-to-load, and auxiliary subsystems are individually outlined. Five modes of operation are described: collector-to-storage, storage-to-DHW preheat; DHW storage-to-preheat, DHW circulation and distribution; and auxiliary-to-DHW heating. Performance evaluation instrumentation for the National Solar Data Network is also described. Original cost estimate for provisioning and installation of the solar energy system are given. DOE

N83-25202# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 14: FOR LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO, JULY AND AUGUST 1982

T. D. HARRISON Dec. 1982 48 p (Contract DE-AC04-76DP-00789) (DE83-005381, SAND-81-7085/14) Avail: NTIS HC A03/MF A01

Data accumulated during July and August at the intermediate photovoltaic project at Lovington Square Shopping Center, Lovington, New Mexico are presented. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities which are attributable to weather are provided. DOE

N83-25215# Mitre Corp., McLean, Va. METREK Div.
TECHNOLOGY ASSESSMENT OF SOLAR-ENERGY SYSTEMS. MATERIALS RESOURCE AND HAZARDOUS MATERIALS IMPACTS OF SOLAR DEPLOYMENT

Y. M. SCHIFFMAN and J. E. TAHAMI Apr. 1982 90 p refs (Contract DE-AC01-80EV-10354) (DE83-005048; MTR-82W59) Avail: NTIS HC A05/MF A01

The materials-resource and hazardous-materials impacts were determined by examining the type and quantity of materials used in the manufacture, construction, installation, operation and maintenance of solar systems. The materials requirements were

compared with US materials supply and demand data to determine if potential problems exist in terms of future availability of domestic supply and increased dependence on foreign sources of supply. Hazardous materials were evaluated in terms of public and occupational health hazards and explosive and fire hazards. It is concluded that: although large amounts of materials would be required, the US had sufficient industrial capacity to produce those materials, (2) postulated growth in solar technology deployment during the period 1995-2000 could cause some production shortfalls in the steel and copper industry; the U.S. could increase its import reliance for certain materials such as silver, iron ore, and copper; however, shifts to other materials such as aluminum and polyvinylchloride could alleviate some of these problems. DOE

N83-25587*# National Aeronautics and Space Administration. Pasadena Office, Calif.

PHOTOELECTROCHEMICAL ELECTRODES Patent Application
R. M. WILLIAMS (JPL, California Inst. of Tech., Pasadena) and A. REMBAUM, inventors (to NASA) (California Inst. of Tech., Pasadena) 10 May 1982 29 p
(NASA-CASE-NPO-15458-1; US-PATENT-APPL-SN-376306)
Avail: NTIS HC A03/MF A01 CSCL 20L

The surface of a moderate band gap semiconductor such as p-type molybdenum sulfide is modified to contain an adherent film of charge mediating ionene polymer containing an electroactive unit such as bipyridinium. Electron transport between the electrode and the mediator film is favorable and photocorrosion and recombination processes are suppressed. Incorporation of particles of catalyst such as platinum within the film provides a reduction in over-voltage. The polymer film is readily deposited on the electrode surface and can be rendered stable by ionic or addition cross-linking. Catalyst can be predispersed in the polymer film or a salt can be impregnated into the film and reduced therein.

NASA

N83-25840# California Univ., Berkeley Lawrence Berkeley Lab Materials and Molecular Research Div.

THERMAL DECOMPOSITION OF MAGNESIUM AND CALCIUM SULFATES Ph.D. Thesis

S. L. ROCHE Apr 1982 88 p refs

(Contract W-7405-ENG-48)

(DE82-015000, LBL-14303) Avail: NTIS HC A05/MF A01

The effect of catalyst on the thermal decomposition of MgSO_4 and CaSO_4 in vacuum was studied as a function of time in Knudsen cells and for MgSO_4 , in open crucibles in vacuum in a Thermal Gravimetric Apparatus. Platinum and Fe_2O_3 were used as catalysts. The CaSO_4 decomposition rate was approximately doubled when Fe_2O_3 was present in a Knudsen cell. Platinum did not catalyze the CaSO_4 decomposition reaction. The initial decomposition rate for MgSO_4 was approximately 5 times greater than when additives were present in Knudsen cells but only about 1.5 times greater when decomposition was done in an open crucible. DOE

N83-25914# Lincoln Lab., Mass. Inst. of Tech., Lexington.

SAFETY-INSPECTION GUIDELINES FOR PHOTOVOLTAIC RESIDENCES

S. E. FORMAN and D. N. KLEIN Jan. 1982 43 p refs

(Contract DE-AC02-76ET-20279)

(DE82-017235; DOE/ET-20279/195) Avail: NTIS HC A03/MF

A01

A set of interim inspection guidelines is given to assess the safety of a residential PV system until more formal documentation is available from code-generating groups. The guidelines address the electrical and mechanical installation. DOE

N83-26085# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

EVALUATION OF PUMPS AND MOTORS FOR PHOTOVOLTAIC WATER-PUMPING SYSTEMS

D. WADDINGTON and A. HERLEVICH Jun 1982 57 p refs

(Contract DE-AC02-77CH-00178)

(DE82-019163; SERI/TR-214-1423) Avail: NTIS HC A04/MF A01

Two electric, motor driven water pumps were tested in conjunction with a photovoltaic (PV) array that provided the electrical energy to run the pumps. The performance of available, low cost pumping systems powered by PV arrays was evaluated. The performance and cost of these systems were compared with analogous data from similar, higher priced pumps and motors used with many PV water pumping systems. The two pump systems considered represent production equipment available from U.S. industry and cost less than 50% of equivalent pumps installed with PV pumping systems in the United States and in developing countries. Flow rates, pumping heads, and efficiency were comparable in both test pumps and equivalent pumps. Motor performance when the motor was directly connected to the PV array and loaded with the pump was examined. The conclusion drawn from this experiment is that commercially available, low cost water pump systems will perform satisfactorily when powered by PV arrays. DOE

N83-26257# Los Alamos Scientific Lab., N. Mex. Solar Energy Group.

PASSIVE TEST CELL DATA FOR THE SOLAR LABORATORY WINTER, 1980-81

R. D. MCFARLAND May 1982 83 p refs

(Contract W-7405-ENG-36)

(LA-9300-MS) Avail: NTIS HC A05/MF A01

Testing was done primarily to determine the relative efficiency of various passive solar heating concepts and to obtain data that could be used to validate computer simulation programs. The passive solar systems tested were Trombe wall with and without selective absorber, water wall, phase change wall, direct gain, a heat pipe collector, and two sunspace geometries. The heating load coefficient of these cells was roughly 26 Btu/h deg F and the collector area was 23.4 sq ft, giving a load collector ratio of approximately 27 Btu/deg F day sq ft. The test cell configurations and instrumentation are detailed, and the resulting data and cell efficiencies are discussed. S.L.

N83-26258*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

SOLAR ENERGY CONVERTER USING SURFACE PLASMA WAVES Patent Application

L. M. ANDERSON, inventor (to NASA) 19 Apr 1983 14 p

(NASA-CASE-LEW-13827-1; US-PATENT-APPL-SN-486470)

Avail: NTIS HC A02/MF A01 CSCL 10A

Sunlight is dispersed over a diffraction grating formed on the surface of a conducting film on a substrate. The angular dispersion controls the effective grating period so that a marching spectrum of surface plasmons is excited for parallel processing on the conducting film. The resulting surface plasmons carry energy to an array of inelastic tunnel diodes. This solar energy converter does not require different materials for each frequency band, and sunlight is directly converted to electricity in an efficient manner by extracting more energy from the more energetic photons. NASA

N83-26269# Battelle Columbus Labs., Ohio.

DESIGN AND MARKET STUDY OF RETROFIT PHOTOVOLTAIC SYSTEMS FOR COMMERCIAL BUILDINGS AND APPLICATIONS. VOLUME 1: EXECUTIVE SUMMARY

G. T. NOEL, J. R. HAGELY, J. H. BROEHL, L. H. STEMBER, J. L. RUCKMAN, and W. R. HUSS Mar. 1982 116 p Prepared for Sandia Labs., Livermore, Calif.

(Contract DE-AC04-76DP-00789)

(DE82-019804, SAND-81-7179/1) Avail: NTIS HC A06/MF A01

A study was performed of the potential market for retrofit photovoltaic systems in commercial, institutional, and industrial applications. It includes assessments of the inventory of potential applications and of PV systems related characteristics of buildings. Detailed PV systems designs appropriate for 12 highly ranked retrofit applications are presented along with estimated costs. Retrofit construction and installation techniques are illustrated and the results of life-cycle costing and market penetration analyses are discussed. DOE

N83-26270# Boeing Commercial Airplane Co., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. VOLUME 8: LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO Executive Summary

Mar. 1982 8 p refs

(Contract DE-AC04-76DP-00789)

(DE82-014248; SAND-81-7099/8) Avail: NTIS HC A02/MF A01

For the month of February 1982, performance data are summarized for a 100 kW-peak, flat panel, grid-connected photovoltaic power supply at a New Mexico shopping center. Data given include daily and monthly energy produced, daily and monthly insolation, array efficiency, power conditioner efficiency, photovoltaic system efficiency, and capacity factor. Also given is a data acquisition mode and recording interval plot that gives for each day the daylight hours with the system on and with it off, nighttime hours, and those hours for which no data were acquired. DOE

N83-26271# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT FOR MISSISSIPPI COUNTY COMMUNITY COLLEGE, BLYTHEVILLE, ARKANSAS

Jul. 1982 28 p refs Prepared for Sandia Labs., Livermore, Calif.

(Contract DE-AC04-76DP-00789)

(DE82-019877, SAND-81-7091/1) Avail: NTIS HC A03/MF A01

The data accumulated during March 1982 at the photovoltaic project site at the Mississippi County Community College, Blytheville, Arkansas is presented. Generated power and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-26272# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 8: NEWMAN POWER STATION, EL PASO, TEXAS

Feb. 1982 25 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.

(Contract DE-AC04-76DP-00789)

(DE82-012059; SAND-81-7086/8) Avail: NTIS HC A02/MF A01

For the month of January, 1982, performance data are given for a photovoltaic power supply used by a Texas electric utility. Data presented include: daily and monthly electrical energy produced; daily and monthly solar energy incident on the array; daily and monthly array efficiency; plots of energy produced as a function of power levels, voltage, cell temperature, and hour of day, electrical energy supplied by the photovoltaic system to the load and the corresponding dollar value; photovoltaic system efficiency; capacity factor; daily photovoltaic power supplied to the load; daily system availability; hourly and monthly insolation, hourly and monthly ambient temperature, hourly and monthly

average wind speed, wind direction distribution; number of freeze/thaw cycles, heating and cooling degree days, hourly cell temperature, daily data acquisition mode and recording interval plot. Also included are brief summaries of problems, operations and maintenance events. DOE

N83-26273# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 9: LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO

Mar. 1982 27 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.

(Contract DE-AC04-76DP-00789)

(DE82-018345; SAND-81-7085/9) Avail: NTIS HC A03/MF A01

Performance data are presented for a photovoltaic power supply at a New Mexico shopping center for the month of February 1982. Data given include: daily and monthly electrical energy produced; daily and monthly incident solar energy; daily and monthly array efficiency; energy production as a function of power level, voltage, cell temperature, and hour of the day; power conditioner input, output, and efficiency for two individual units and for the total system; system efficiency for the month, daily and monthly photovoltaic energy to the load; dollar value of the photovoltaic energy for the month; capacity factor, daily availability; daily and hourly insolation; monthly and hourly ambient temperature; heating and cooling degree days; number of freeze/thaw cycles; hourly and monthly wind speed, wind direction distribution, and the data acquisition mode and recording interval plot. Also included are summaries of 5 site events. DOE

N83-26274# AIA Research Corp., Washington, D. C.

RESIDENTIAL DESIGN SENSITIVITY ANALYSIS

G. C. ROYAL, III Mar. 1982 74 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.

(Contract DE-AC04-76DP-00789)

(DE82-013531, SAND-81-7045) Avail: NTIS HC A04/MF A01

The effect passive solar heating strategies has on residential photovoltaic (PV) system performance in 1986 was identified. In addition, previous design and analysis studies conducted by General Electric and Westinghouse were evaluated to determine whether passive heating would significantly alter their results. Passive heating contributions were found to reduce interaction of the PV system with the load. However, the differences in displaced utility electricity between small and large passive contributions are small. These results show the relative insensitivity of PV system performance to large amounts of passive solar heating. Once daytime heating is achieved through suntempering, any further passive contribution has minimal effect on daytime electrical heating loads. Incorporation of passive heating systems in a residence does not affect the definition of optimum PV system size. Author

N83-26275# General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div

DESIGN OF A PHOTOVOLTAIC SYSTEM FOR A TEMPERATE CLIMATE ALL-ELECTRIC RESIDENCE

E. M. MEHALIK, G. F. TULLY, J. JOHNSON, N. TRUNCELLITO, and R. SCHAEFFER Jan 1982 164 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.

(Contract DE-AC04-76DP-00789)

(DE82-008207; SAND-80-7173) Avail: NTIS HC A08/MF A01

A photovoltaic system was developed and integrated into a single story residence having low space conditioning loads typical of a temperate climate similar to Santa Maria, CA. The design addresses the residential market segment of low energy consuming houses with limited roof area availability; in fact the garage roof is used for the array. The array size to meet the requirements of this type of house covers 40 square m with a rated power output of 4.3 kW at NOCT conditions. A flexible array installation is presented which can be implemented as an integral mount or a stand-off mount depending on the homeowner preference. A 4 kW utility-tied inverter is used in the power conversion subsystem, representative of currently available hardware. The system provides

feedback of excess energy to the utility which is the most promising approach for grid-connected residential systems in the mid 1980's. DOE

N83-26276# Oak Ridge National Lab, Tenn
RESULTS OF THE HARMONICS MEASUREMENT PROGRAM AT THE JOHN F. LONG PHOTOVOLTAIC HOUSE

G. L. CAMPEN Mar. 1982 125 p refs
 (Contract W-7405-ENG-26)
 (DE82-008893; ORNL-5834) Avail: NTIS HC A06/MF A01

Photovoltaic (PV) systems used in single-family dwellings require an inverter to act as an interface between the direct-current (dc) power output of the PV unit and the alternating-current (ac) power needed by house loads. A type of inverter known as line commutated injects harmonic currents on the ac side and requires large amounts of reactive power. Large numbers of such PV installations could lead to unacceptable levels of harmonic voltages on the utility system, and the need to increase the utility's deliver of reactive power could result in significant cost increases. The harmonics and power-factor effects are examined for a single PV installation using a line-commutated inverter. The magnitude and phase of various currents and voltages from the fundamental to the 13th harmonic were recorded both with and without the operation of the PV system. DOE

N83-26279# Clemson Univ, SC Dept of Electrical and Computer Engineering
INVESTIGATION OF LOAD-MANAGEMENT STRATEGIES FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS

J. W. LATHROP and J. F. RUDISILL Mar. 1982 110 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-014434, SAND-82-7104) Avail: NTIS HC A06/MF A01

Described is the development of a computer model which simulates individual residential demand on an instantaneous basis. When combined with a supply model incorporating the utility interface and the option of battery storage the advantage of various load management strategies may be investigated in terms of system life cycle cost. Sample runs for Boston and Albuquerque illustrate use of the evaluation technique. Although the load management strategies investigated did not appear particularly cost effective, it was shown that the commonly accepted approach of using hourly demand averages leads to an overly optimistic view of photovoltaic economics. DOE

N83-26282# Sandia Labs, Albuquerque, N. Mex
PROCEEDING OF THE DOE SOLAR THERMAL TECHNOLOGY PROGRAM PLANNING WORKSHOP

L. G. RADOSEVICH, ed Mar. 1982 58 p refs Workshop held at Gettysburg, Pa., 3 Nov 1981
 (Contract DE-AC04-76DP-00789)
 (DE82-012237; SAND-82-8214, CONF-811193-SUMM) Avail: NTIS HC A04/MF A01

The workshop reviewed several strategies for solar thermal technology program planning. After the strategy options were presented to the workshop participants, each committee (user/supplier, system test and evaluation, technology development, and research) was asked to address the following issues: which strategy shows the best potential for meeting the objectives of the solar thermal program; is there an obvious imbalance in the program in terms of emphasis in various areas, are there any activities which should be added or deleted; and, if a funding cut occurs, how should the cut be made. The strategy options are briefly discussed. Summary reports from each committee follow, and a compilation of the committee findings highlights major similarities and differences. DOE

N83-26284# Sandia Labs., Albuquerque, N. Mex.
THE 10-MW/SUB E/ SOLAR-THERMAL CENTRAL-RECEIVER PILOT PLANT: OPERATIONAL TEST REQUIREMENTS

J. J. BARTEL and C. W. MOORE May 1982 103 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-015869; SAND-79-8037) Avail: NTIS HC A05/MF A01

The operational test requirements are defined for the 10 MW/sub e/ Central Receiver Pilot Plant near Barstow, California. Top level requirements are presented from which specific tests will be developed, and information is provided on the objectives, test schedule, types and duration of tests, instrumentation and data acquisition requirements, and data reduction and analysis requirements for the operational tests. DOE

N83-26285# Black and Veatch Consulting Engineers, Kansas City, Mo

DESIGN AND FABRICATION OF AN 1-MW(TH) CERAMIC TUBE BENCH-MODEL SOLAR RECEIVER Summary Report

E. L. COX May 1982 53 p refs Sponsored by Electric Power Research Inst.
 (Contract EPRI PROJ. 475-2)

(DE82-905784; EPRI-AP-2398-54) Avail: NTIS HC A04/MF A01
 The design and fabrication of an 1MWt Bench Model Solar Receiver (BMSR) demonstrated and developed the ceramic tube central receiver concept. Although many of the properties of silicon carbide are well documented, this material was never utilized in an application of this type and size. Further investigation was undertaken to confirm the choice of silicon carbide against available metals and other ceramic materials. DOE

N83-26286# Bechtel Corp., San Francisco, Calif.
ADVANCED CONCEPTUAL DESIGN FOR SOLAR REPOWERING AT PIONEER MILL CO., LTD. Final Report

May 1982 435 p refs
 (Contract DE-AC03-81SF-11567)
 (DE82-017681; DOE/SF-11567/1) Avail: NTIS HC A19/MF A01

An advanced conceptual design for a solar repowering facility has been prepared for a Hawaii sugar factory. A baseline conceptual design is summarized as a starting point and the tradeoff studies that were performed are described. The results of a review of the available relevant data covering both solar component development and site-specific parameters, and the tradeoff studies conducted during the refinements of the baseline conceptual design into the advanced conceptual design are described. The systems of the advanced conceptual design of the solar repowering facility are described in detail, including the collector system, the receiver system, the thermal transport system, the master system, and the nonsolar energy system. The description of each system includes details of the major components and their locations, functional requirements, design and operating characteristics, performance estimates, and cost estimates. DOE

N83-26288# Martin Marietta Aerospace, Denver, Colo.
THE 2.2-KILOWATT PHOTOVOLTAIC CONCENTRATOR ARRAY

Jan. 1982 100 p
 (Contract DE-AC04-76DP-00789)
 (DE82-012062, SAND-81-7009) Avail: NTIS HC A05/MF A01

Martin Marietta's design, fabrication and installation of an active cooling system for their 2.2 kW pedestal mounted Fresnel lens photovoltaic array is described. The previous design used a finned extruded aluminum passive heat exchanger to keep the solar cells cool. The actively cooled rectangular extruded aluminum channel through which coolant flows and cools the cells. The channel is attached at its center to the tracking structure and it supports two 1 ft. by 4 ft. modules (as with the passive design). The channels for side-by-side module pairs are connected by cast headers and flexible hoses. Coolant flows from module pair to module pair in a serpentine path through the array. DOE

02 SOLAR ENERGY

N83-26292# Sandia Labs., Albuquerque, N Mex Experimental Systems Operation Div.

MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA OF LOW- TO MEDIUM-TEMPERATURE LINE-FOCUSING SOLAR COLLECTORS. SUNPOWER SYSTEMS SOLAR COLLECTORS

T. D. HARRISON Feb 1982 54 p refs

(Contract DE-AC04-76DP-00789)

(DE82-012609; SAND-82-0092/3) Avail. NTIS HC A03/MF A01

Thermal performance predictions based on test data are presented for the Sunpower Systems solar collector for three output temperatures at eight cities in the United States. DOE

N83-26293# Sandia Labs., Albuquerque, N. Mex. Experimental Systems Operations Div

MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA OF LOW- TO MEDIUM-TEMPERATURE LINE-FOCUSING SOLAR COLLECTORS. WHITELINE MODEL W-11A COLLECTOR

T. D. HARRISON Feb. 1982 23 p refs

(Contract DE-AC04-76DP-00789)

(DE82-012057; SAND-82-0092/4) Avail: NTIS HC A02/MF A01

Thermal performance predictions based on test data are presented for the Whiteline Model W-11A solar collector for three output temperatures at eight cities in the United States DOE

N83-26297# Mueller Associates, Inc., Baltimore, Md
PHOTOVOLTAICS: STATE-OF-KNOWLEDGE SURVEY OF ENVIRONMENTAL, HEALTH AND SAFETY ASPECTS

Jun 1982 103 p refs Prepared in cooperation with JPL

(Contract DE-AC01-81EV-10450)

(DE83-005068; DOE/EV-10450/T2) Avail NTIS HC A06/MF A01

The environmental, health and safety issues are addressed that have been identified for various photovoltaic technologies/materials, and the results of recent research into specific areas of concern are summarized. A distinction is made between those concerns common to all PV technologies and those specific to a single technology or application. The photovoltaic-energy-system life cycle is conveniently described in terms of four stages: raw-material collection and refining; component manufacture; system installation and operation; and decommissioning and disposal. Research to date has addressed selected issues in each stage of the system life cycle. These include the acquisition and/or application of toxic materials required in certain cell technologies, specific manufacturing processes or process scales, and the environmental effects of large, centralized systems. DOE

N83-26298# Lincoln Lab., Mass Inst of Tech., Lexington.
THE PHOTOVOLTAIC-ARRAY/POWER-CONDITIONING INTERFACE

H. M. BRANZ, G. W. HART, and C. H. COX, III Oct 1982 136 p refs

(Contract DE-AC02-76ET-20279)

(DE83-004946; DOE/ET-20279/170) Avail NTIS HC A07/MF A01

Two years' of effort to improve terrestrial flat-plate photovoltaic (PV) system efficiency through increased understanding of the array/power conditioner interface is reported. The flat-plate PV array is a highly variable source of dc electrical energy due to changing insolation and other factors. Computer simulation based on statistically typical weather data is used to analyze the terrestrial flat-plate PV source and to define the optimal characteristics of its interface with the power-conditioning subsystem. It is found that less than 5% of the annual available energy will be lost by operating most PV systems at a fixed voltage and that even after array degradation, maximum-power-point tracking usually will not present a significantly larger advantage over fixed-voltage operation. Experiments show that open-loop tracking using a new pilot-cell concept is also a viable array-operating strategy. Finally,

power conditioner sizing is examined and techniques are developed for estimating the annual operating efficiency and the maximum dc voltage requirement of a power conditioner DOE

N83-26299# General Electric Co., Philadelphia, Pa Advanced Energy Programs Dept.

INITIAL DETAILED DESIGNS FOR INTERMEDIATE PHOTOVOLTAIC SYSTEMS: BOTTLING PLANT

J. HERZ and G. OBRIEN Aug 1982 287 p refs

(Contract DE-AC04-76DP-000789)

(DE83-004476; SAND-81-7187) Avail NTIS HC A13/MF A01

The detailed design of a 155 kW roof mounted PV-thermal concentrating array system is described and is analyzed for performance and economics. The building architectural features and load demands of the bottling plant are defined, and photovoltaic array, electrical system design, and system installation are defined and discussed. Alternative mechanical design choices are also presented. Appended are a drawing set list, specifications, and installation details. DOE

N83-26301# Los Alamos Scientific Lab., N. Mex
PASSIVE SOLAR DESIGN HANDBOOK. VOLUME 3: PASSIVE SOLAR DESIGN ANALYSIS

R. W. JONES, ed., J. D. BASCOMB, C. E. KOSIEWICZ, G. S. LAZARUS, R. D. MCFARLAND, and W. O. WRAY Jul. 1982 677 p refs

(DE83-006665; DOE/CS-0127/3) Avail. NTIS HC A99/MF A01

Simple analytical methods concerning the design of passive solar heating systems are presented with an emphasis on the average annual heating energy consumption. Key terminology and methods are reviewed. The solar load ratio (SLR) is defined, and its relationship to analysis methods is reviewed. The annual calculation, or Load Collector Ratio (LCR) method, is outlined. Sensitivity data are discussed. Information is presented on balancing conservation and passive solar strategies in building design. Detailed analysis data are presented for direct gain and sunspace systems, and details of the systems are described. Key design parameters are discussed in terms of their impact on annual heating performance of the building. These are the sensitivity data. The SLR correlations for the respective system types are described. The monthly calculation, or SLR method, based on the SLR correlations, is reviewed. Performance data are given for 9 direct gain systems and 15 water wall and 42 Trombe wall systems DOE

N83-26302# Massachusetts Inst of Tech., Cambridge. Energy Lab.

SOLAR DISTRICT-HEATING SYSTEM USING SEASONAL STORAGE FOR THE CHARLESTOWN, BOSTON NAVY YARD REDEVELOPMENT PROJECT

D. BREGER Sep 1982 109 p refs Prepared for Argonne National Lab., Ill

(Contract W-31-109-ENG-38)

(DE83-006184; ANL-82-90) Avail. NTIS HC A06/MF A01

A preliminary analysis is presented for a seasonal storage solar heating system for the Charlestown Navy Yard in Boston, Massachusetts. The system makes use of two large, buried concrete storage tanks totalling 5700 m³ as a water heat store. The analysis makes extensive use of MINSUN, a computer performance and economic simulation routine written specifically for solar seasonal storage systems. The system performance and economics are analyzed for different collector types and areas, component costs, exogenous economic conditions, and optional inclusion of a heat pump. System cost-effectiveness is defined in relation to an economic break-even situation with respect to a conventional system, and is presented in terms of a solar premium, which is the incremented cost for the solar system per megawatt hour (MWH) of conventional fuel displaced. Results indicate a solar premium of about \$15 per MWH for parabolic collectors and \$10 MWH for advanced evacuated tubes given estimated 1985 collector costs. DOE

N83-26304# Boeing Computer Services, Inc., Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION
 EXPERIMENT OPERATION PERFORMANCE REPORT, FOR
 SEPTEMBER 1982. VOLUME 15: FOR LOVINGTON SQUARE
 SHOPPING CENTER, LOVINGTON, NEW MEXICO**
 Jan. 1983 26 p Prepared for Sandia Labs., Albuquerque, N.
 Mex.
 (Contract D-AC04-76DP-00789)
 (DE83-006424, SAND-81-7085/15) Avail NTIS HC A03/MF
 A01

The data accumulated at the intermediate photovoltaic project at Lovington Square Shopping Center, Lovington, New Mexico are presented. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided DOE

N83-26313# Aerospace Engineering Office, Zunch
 (Switzerland).
**STUDY OF INTERNAL STRESSES OF THIN SOLAR CELL
 MODULES Final Report**
 K. J. ZIMMERMANN and U. HAEVERLI Paris ESA 29 Jun.
 1982 49 p refs
 (Contract ESTEC-4815/81/NL-JS(SC))
 (REPT-37-155/NT; ESA-CR(P)-1696) Avail NTIS HC A03/MF
 A01

Three solar cell computer programs were converted from MARC into NASTRAN. The meshes were generated by the AEO interactive SIMP package. The results of these conversions were compared with test results. The computer programs used to compute the interconnector and wiring stresses were implemented into SIMP. By applying fatigue properties of solar cell interconnectors, the life cycle can be determined using thermal distortion results of the solar cell modules. It is shown that the computation of the module internal stresses can be performed within a few days and at a lower cost than the previous analysis steps. Author (ESA)

N83-26314# European Space Agency, Paris (France).
**VALIDATION OF SOLAR COLLECTOR MEASUREMENTS
 UNDER NATURAL AND SIMULATED CONDITIONS**
 W. LEY Feb. 1983 202 p refs Transl into ENGLISH of
 "Bewertung von Solarkollektormessungen unter natuerlichen u
 simulierten Bedingungen" DFVLR, Rept. DFVLR-FB-82-05,
 Cologne (West Germany), 1981 Original report in GERMAN
 previously announced as N82-32891
 (ESA-TT-775, DFVLR-FB-82-05) Avail: NTIS HC A10/MF A01;
 original German version available from DFVLR, Cologne DM
 59,40

The performance characteristics, heat losses, azimuthal angular dependence and effects of different environmental parameters were determined for low temperature flat plate solar collectors, under natural and simulated conditions. Results indicate that outdoor tests can be replaced by indoor measurements, using a simplified solar simulator and a climatic chamber. Author (ESA)

N83-26356# Fondazione Ugo Bordoni, Rome (Italy)
**ANALYSIS OF THE SOLAR RADIATION CHARACTERISTICS
 AT ADRANO [ANALISI DELLE CARATTERISTICHE DELLA
 RADIAZIONE SOLARE AT ADRANO]**
 F. BARBALISCA and A. LAVAGNINI (Ist. di Fisica dell'Atmosfera,
 Rome) May 1982 65 p refs In ITALIAN Sponsored by
 Ente Nazionale per l'Energia Electrica
 (FUB-12-1982) Avail: NTIS HC A04/MF A01

The distribution functions of solar radiation were determined using both a 30 sec base and a 10 to 60 min base. The data will be used for the design of a solar generator system at Adrano (Italy). Cumulative solar radiation by month, season and year was determined. The short and long term variabilities are discussed. It is shown that the measurements carried out on a 10 min base are practically equivalent to those from a 60 min base in determining the distribution function, while the shorter term measurements are not entirely equivalent. Author (ESA)

N83-26968# EIC, Inc., Newton, Mass.
**DEVELOPMENT OF PHOTOELECTROCHEMICAL CELLS BASED
 ON COMPOUND SEMICONDUCTORS AND NONAQUEOUS
 ELECTROLYTES Semiannual Report, 1 May - 31 Oct. 1981**
 R. D. RAUH, M. E. LANGMUIR, R. A. BOUDREAU, and M. A.
 PARKER Mar. 1982 67 p refs
 (Contract EG-77-C-01-4042; DE-AC02-77CH-00178)
 (DE82-013700, SERI/PR-8001-7-T4) Avail. NTIS HC A04/MF
 A01

A reproducible procedure for chemical bath deposition (CBD) of CdSe was documented in detail, allowing a consistent production of photoelectrode yielding 5.5 to 6.5% conversion efficiency in alkaline polysulfide electrolyte (employing a tungsten halogen lamp/KG-2 filter solar simulated light source). The CBD films of n-CdSe on Ti have achieved an efficiency of approximately 10% under both solar simulated and real sunlight conditions using a Fe(cn)₆ (-3/-4) electrolyte at pH13. For an initial current density of 16 mA/square cm (approximately 80 mW/square cm illumination), a decrease of approximately 25% is observed after 3 hours illumination. Research was completed on developing a stable Cu (+/+2) redox electrolyte in CH₃CN, which contains excess Cl (-), to promote photochemical stability. For poly-n-GaAs, best results were obtained for electrolytes containing approximately 0.5m CuCl, 0.05m CuCl₂ and 1m tetrabutylammonium chloride. DOE

N83-27140# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**ISOLATION TRANSFORMERS FOR UTILITY-INTERACTIVE
 PHOTOVOLTAIC SYSTEMS**
 E. C. KERN, JR Dec 1982 34 p refs
 (Contract DE-AC02-76ET-20279)
 (DE83-006914; DOE/ET-20279/237) Avail. NTIS HC A03/MF
 A01

Isolation transformers are used in some photovoltaic systems to isolate the photovoltaic system common mode voltage from the utility distribution system. In early system experiments with grid connected photovoltaics, such transformers were the source of significant power losses. A project at the Lincoln Laboratory and at Allied Chemical Corporation developed an improved isolation transformer to minimize such power losses. Experimental results and an analytical model of conventional and improved transformers are presented, showing considerable reductions of losses associated with the improved transformer. DOE

N83-27357# California Univ., Berkeley. Lawrence Berkeley Lab.
 Energy and Environment Div
**TRANSPARENT HEAT-MIRROR MATERIALS AND DEPOSITION
 TECHNOLOGY**
 C. M. LAMPERT, comp. and S. SELKOWITZ, comp. Jul. 1982
 115 p refs Proc. of the Conf. on Opt. Coatings for Energy
 Efficiency and Solar Appl. and the Conf. on Opt. Thin Films, Los
 Angeles, 25-29 Jan 1982; sponsored by the Society for Optical
 Engineering
 (Contract DE-AC03-76SF-00098)
 (DE83-007042, LBL-15258) Avail: NTIS HC A06/MF A01

Advanced solar optical films and heat-mirror materials, properties of heat mirrors on glass substrates, properties of heat-mirrors on polymeric substrates, and large-scale processing technology are discussed.

N83-27358# California Univ., Berkeley. Lawrence Berkeley Lab.
 Materials and Molecular Research Div.
**DURABLE INNOVATIVE SOLAR OPTICAL MATERIALS: THE
 INTERNATIONAL CHALLENGE**
 C. M. LAMPERT In its Transparent Heat-Mirror Mater. and
 Deposition Technol. p 1-8 Jul. 1982 refs
 (Contract W-7405-ENG-48)
 Avail: NTIS HC A06/MF A01

A variety of optical coatings is discussed in the context of solar energy utilization. Well known coatings such as heat mirrors, selective absorbers, and reflective films are covered briefly. Emphasis is placed on the materials limitations and design choices for various lesser known optical coatings and materials. Physical

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and optical properties are detailed for protective antireflection films, fluorescent concentrator materials, holographic films, cold mirrors, radiative cooling surfaces, and optical switching films including electrochromic, thermochromic, photochromic, and liquid crystal types. For many of these materials research is only now being considered, and various design and durability issues must be addressed. Author

N83-27359# Leybold-Heraeus G.m.b.H., Hanau/Main (West Germany) Dept of Large-Scale Coating Systems

LOW EMISSIVITY AND SOLAR CONTROL COATINGS ON ARCHITECTURAL GLASS

W. D. DACHSELT, W. D. MUNZ, and M. SCHERER /in Lawrence Berkeley Lab. Transparent Heat-Mirror Mater. and Deposition Technol. p 9-16 Jul 1982 refs

Avail: NTIS HC A06/MF A01

Methods of depositing thin films on glass using the vacuum coating technic were developed to impede the transfer of heat through glass thus reducing the energy costs for room heating or air conditioning. Heat reflecting so-called low emissivity coatings permit a maximum amount of daylight to pass through, but then block the heat that is generated when light strikes an object (greenhouse effect). They are composed of metals like silver or copper sandwiched in selected oxide films or they are transparent semi-conducting monofilms. Double glazed insulating units with coated glass achieve k-values in the order of magnitude 1.8 to 1.5 Watts per squaremeters and degree Kelvin. Maximum available transmittance values at $\lambda = 550$ nm are 85% (single pane), maximum reflectance values are 93% measured at $\lambda = 8$ microns. The corresponding emissivities are around 0.1. The investigated low-e films are stable within 1% concerning transmittance and sheet resistance changes when exposed to elevated temperatures in air of up to 150 C. Solar control films used to keep out sunheat are sputtered in a reactive gas atmosphere on the base of titanium, stainless steel or chromium. Reflectance values of 32% are achieved at a transmission of e.g. 8%. The shading coefficient b is about 0.27. Large-scale production equipment for sputter deposition of the cited films is introduced.

Author

N83-27360# American Cyanamid Co., Stamford, Conn. Chemical Research Div

MATERIALS FOR TRANSPARENT HEAT MIRROR COATINGS

G. HAACKE /in Lawrence Berkeley Lab. Transparent Heat-Mirror Mater. and Deposition Technol. p 17-22 Jul 1982 refs

Avail: NTIS HC A06/MF A01

Transparent heat mirrors can be constructed from single- or multi-layer coatings. For single-layer mirrors wide-band-gap semiconductors are the best available materials. The required fundamental semiconductor properties are reviewed and experimental data of binary and ternary compounds discussed.

Author

N83-27361# Uppsala Univ. (Sweden) Dept. of Solid State Physics.

OPTICAL PROPERTIES OF TRANSPARENT HEAT MIRRORS BASED ON THIN FILMS OF TIN, ZRN, AND HFN

B. KARLSSON and C. G. RIBBING /in Lawrence Berkeley Lab. Transparent Heat-Mirror Mater. and Deposition Technol. p 23-28 Jul. 1982 refs

Avail: NTIS HC A06/MF A01

Calculations of the transmittance and reflectance between 0.35 microns and 10 microns of semitransparent films of TiN, ZrN and HfN were performed. The calculations are based on recently reported optical constants. They show that these compounds can be used as transparent heat-mirrors. These materials show considerable higher emittance than noble-metals but comparable or higher visible transmittance. It is also shown that the transmittance can be increased by the technique of induced transmission.

Author

N83-27364# Loughborough Univ. of Technology (England). Dept of Physics

HEAT MIRRORS ON PLASTIC SHEET USING TRANSPARENT OXIDE CONDUCTING COATINGS

R. P. HOWSON and M. I. RIDGE /in Lawrence Berkeley Lab. Transparent Heat-Mirror Mater. and Deposition Technol. p 45-52 Jul 1982 refs

Avail: NTIS HC A06/MF A01

A technique of reactive d.c. magnetron sputtering with RF substrate bias was evolved to give metal oxide films which exhibit heat reflecting properties while remaining highly transparent. Films of indium-tin, indium and cadmium-tin oxide were deposited onto plastic sheet at room temperature at rates of greater than 0.5 microns/min. Preliminary assessments of durability with accelerated weathering with exposure to high UV levels and high humidities gave very encouraging results. The properties achieved with a single coating of about 300 nm of oxide to a 50 microns thick P.E.T. sheet are visible transmittances of over 70% with heat emissivities lower than 0.3. These properties are commensurate with them providing an energy and cost effective addition to new and existing windows. Author

N83-27366# Leybold-Heraeus G.m.b.H., Hanau/Main (West Germany). Dept of Research and Development for Coating

PERFORMANCE AND SPUTTERING CRITERIA OF MODERN ARCHITECTURAL GLASS COATINGS

W. D. NUNZ and S. R. REINECK /in Lawrence Berkeley Lab. Transparent Heat-Mirror Mater. and Deposition Technol. p 61-70 Jul 1982 refs. Sponsored by Bundesministerium fuer Forschung und Technologie

Avail: NTIS HC A06/MF A01

The specific requirements to the magnetron cathode to reach special film properties are described. For the solar control films a low magnetic field strength version of the magnetron cathode is used to improve film hardness. For the heat mirror coatings a high magnetic field strength version of the magnetron cathode is described, especially to prevent the oxidation of IR-reflecting intermediate metal film. Optical values of solar control films on the base of stainless steel and titanium are given. Special color effects, especially in reflection are described. Heat mirrors are exhibited as three films systems with silver or copper as the intermediate metal films. Transmission and reflectivity values are reported. Author

N83-27386# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst

CONCEPTUAL DESIGN OF THE TRUSCOTT BRINE LAKE SOLAR POND SYSTEM. VOLUME 2: UTILITY-INTEGRATED SCENARIO

E. K. MAY, C. M. LEBOEUF, and D. WADDINGTON Dec 1982 87 p refs

(Contract DE-AC02-77CH-00178)

(DE83-008133, SERI/TR-253-1833-VOL-2) Avail: NTIS HC A05/MF A01

Conceptual designs were developed for salt gradient solar pond systems to provide pumping power for chloride control in the Red River Basin. Energy is extracted from six, 10.5 ha (26 acre) solar ponds for conversion to electricity using three organic Rankine cycle turbines. The solar pond system is located in a brine impoundment lake at Truscott, Texas. Low salinity brine flowing into this lake is concentrated by natural evaporation to form the solar pond, and is also used for solar pond maintenance. Two operating scenarios were investigated. A continuous base load system could deliver 9.8 GWh/yr at an output of 1120 kW to the utility electric grid for an estimated capital expenditure of \$12.8 million. A system operating only from June through September would cost \$21.2 million for an annual energy delivery of 7.7 GWh at a net output during the operating period of 2640 kW. DOE

N83-27399# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL PHOTOVOLTAIC SYSTEM SIMULATION: THERMAL ASPECTS

G W HART and P. RAGHURAMAN 1982 9 p refs Presented at the ASME Solar Energy Conf., Albuquerque, N. Mex., 26 Apr. 1982

(Contract DE-AC02-76ET-20279)

(DE82-007784; DOE/ET-20279/183, CONF-820410-7) Avail.

NTIS HC A02/MF A01

A TRNSYS simulation was developed to simulate the performance of utility interactive residential photovoltaic energy systems. The PV system is divided into its major functional components, which are individually described with computer models. These models are described in detail. The results of simulation and actual measured data obtained at MIT Lincoln Laboratory's Northeast Residential Station are compared. The thermal influences on the design of such photovoltaic energy systems are given particular attention. DOE

N83-27407# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. EXECUTIVE SUMMARY FOR NEWMAN POWER STATION, EL PASO, TEXAS

Jul. 1982 8 p Prepared for Sandia Labs., Albuquerque, N. Mex. 6 Vol.

(Contract DE-AC04-76DP-00789)

(DE82-019965; SAND-81-7100/10) Avail. NTIS HC A02/MF A01

Presented are the data accumulated during April 1982 at the photovoltaic project site at the Newman Power Station, El Paso, Texas. Generated power and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-27408# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. EXECUTIVE SUMMARY FOR OKLAHOMA CENTER FOR SCIENCE AND ARTS, OKLAHOMA CITY, OKLAHOMA

Jul. 1982 8 p Prepared for Sandia Labs., Albuquerque, N. Mex. 6 Vol.

(Contract DE-AC04-76DP-00789)

(DE82-019964; SAND-81-7101/2) Avail. NTIS HC A02/MF A01

Presented are the data accumulated during April 1982 at the photovoltaic project site at the Oklahoma Center for Science and Arts, Oklahoma City, Oklahoma. Generated power and environmental (weather) data are presented graphically. Explanations of irregularities are attributable to weather are provided. The system was inoperative all month due to a failed power conditioning unit. DOE

N83-27409# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. EXECUTIVE SUMMARY. VOLUME 6: BEVERLY HIGH SCHOOL, BEVERLY, MASSACHUSETTS

Apr. 1982 7 p Prepared for Sandia Labs., Albuquerque, N. Mex. 6 Vol.

(Contract DE-AC04-76DP-00789)

(DE82-015660; SAND-81-7102/6) Avail. NTIS HC A02/MF A01

Performance data are given for a 95 kW-peak grid connected flat panel photovoltaic power supply at a Massachusetts high school for the month of March 1982. Data presented include daily and monthly electrical energy produced by the photovoltaic system, daily and monthly solar energy incident in the plane of the array, efficiency of the solar cell array and of the power conditioner and of the system overall, the capacity factor, solar insolation, and the data acquisition mode and recording interval plot. DOE

N83-27411# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. EXECUTIVE SUMMARY FOR CDC LIGHT MANUFACTURING BUILDING, SAN BERNARDINO, CALIFORNIA

Jul. 1982 8 p Prepared for Sandia Labs., Albuquerque, N. Mex. 6 Vol.

(Contract DE-AC04-76DP-00789)

(DE82-019962; SAND-81-7103/2) Avail. NTIS HC A02/MF A01

Presented are the data accumulated during April 1982 at the photovoltaic project site at the CDC Light Manufacturing Bldg., San Bernardino, California. Generated power and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-27412# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. EXECUTIVE SUMMARY FOR MISSISSIPPI COUNTY COMMUNITY COLLEGE, BLYTHEVILLE, ARKANSAS

Jul. 1982 8 p Prepared for Sandia Labs., Albuquerque, N. Mex. 6 Vol.

(Contract DE-AC04-76DP-00789)

(DE82-019966; SAND-81-7105/1) Avail. NTIS HC A02/MF A01

Presented are the data accumulated during March 1982 at the photovoltaic combined collector project site at the Mississippi County Community College, Blytheville, Arkansas. Generated power and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-27419# Los Alamos Scientific Lab., N. Mex.
ECONOMIC ANALYSIS OF THE INTEGRATED HEATING AND COOLING POTENTIAL OF A RESIDENTIAL PASSIVE-SOLAR WATER WALL DESIGN

F. ROACH, C. MANGENG, C. KIRSCHNER, and S. BEN-DAVID 1982 6 p refs Presented at 7th Natl Solar Conf., Knoxville, Tenn., 29 Aug. 1982 Prepared in cooperation with New Mexico Univ., Albuquerque

(DE82-018372; LA-UR-82-1667; CONF-820819-5) Avail. NTIS HC A02/MF A01

Preliminary performance estimates for the heating and cooling potential of water walls were made. These estimates include the Btu displacement that is attributable to a 300-square foot water wall design in a 1200-square foot residence. The design is for a forced ventilation water wall system that includes the fans and ducting necessary to achieve a 3000-cfm flow of air. The cooling and heating energy displacement estimates are combined with appropriate region-specific fuel prices, system costs, and general economic parameters in a lifecycle cost analysis of this fixed-size water wall design. The economic indicators used to discuss the results include net present value and a total cost goal. Input data and results are presented in mapped form and used to assess the energy savings potential of the water wall in 220 regions of the continental United States. DOE

N83-27421# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION: SOUTH BRIDGE TOWERS NO. 6 MULTI-FAMILY COOPERATIVE, NEW YORK CITY, NEW YORK

30 Jun. 1982 50 p refs

(Contract DE-AI01-76CS-31020)

(DE82-019252; SOLAR/1101-82/50) Avail. NTIS HC A03/MF A01

The South Bridge Towers, Inc. solar energy system is a high-rise cooperative apartments subdivision located in New York City, New York. The solar energy collector subsystem is located on the roof of the 27-story tower and consists of 150 flat plate collectors arranged in six arrays. The collectors have a total gross area of 3790 square feet and a net aperture area of 3150 square feet. The collectors are inclined at an angle of 40 deg to horizontal, and oriented to face 14 degrees west of south. Solar energy is stored in a 4000 gallon carbon steel tank located on the tower

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roof The system uses a solar energy transport medium of one-half water and one-half propylene glycol in the collector loop. Solar energy, gathered in the collector loop, is transferred to the domestic water storage subsystem by circulating the water through the collector loop heat exchanger and the storage tank DOE

N83-27423# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany)

IEA SMALL SOLAR-POWER-SYSTEM PROJECT, OPERATION STATUS

Apr. 1982 23 p

(Contract DE-AC04-76DP-00789)

(DE82-020001; DOE/NBM-2020001) Avail NTIS HC A02/MF A01

Data collected from routine operation of the Small Solar Power Systems Project are summarized, and an overview is given of the data evaluation. The operation status of the data collection system and central receiver system is included as well as the status of the evaluation work organization. Some insolation and wind data are given. Tours by visitors are reported and the status of existing reports is given. DOE

N83-27433# General Electric Co., Philadelphia, Pa.

DESIGN AND DEVELOPMENT OF A HIGH-CONCENTRATION PHOTOVOLTAIC CONCENTRATION (2-D)

R. C HODGE 1982 6 p refs Presented at 16th IEEE Photovoltaics Specialists Conf., San Diego, Calif, 28 Sep. 1982 (Contract DE-AC04-76DP-00789)

(DE82-008924, SAND-82-7034C, CONF-820906-1) Avail NTIS HC A02/MF A01

Some results are given of a program to design and develop a high concentration concentrator solar cell module which will take advantage of the high efficiency demonstrated by the latest high concentration solar cells. The concentrator is a curved groove domed Fresnel lens. The complete module is briefly described and illustrated and performance results are given. Cell efficiency at 1000X concentration reached 14 to 16%, and the power output/cell area at illuminance of 1 kW/sq m was 4 to 6 W/sq m DOE

N83-27434# BDM Corp., Albuquerque, N. Mex

COLLECTOR TRADE-OFF STUDY FOR BDM PRDA-35 APPLICATION

Mar 1982 68 p refs

(Contract DE-AC04-76DP-00789)

(DE82-013532, SAND-81-7176) Avail NTIS HC A04/MF A01

An analysis was made by BDM to compare the performance of the T-600 and T-700 linear parabolic collectors from Solar Kinetics Inc. This study was undertaken as an attempt to prevent an increase in the cost of the BDM PRDA-35 contract in the face of a substantial increase in the cost of photovoltaic cells. Electrical and thermal properties were examined using the Photovoltaic Transient Analysis Program (PVTAP) and results were correlated with existing experimental data. This study indicated that the T-700 collector would yield a slightly more cost effective system than would the T-600 collector DOE

N83-27437# Massachusetts Inst of Tech, Cambridge

FLYWHEEL ENERGY-STORAGE-AND-CONVERSION SYSTEM FOR PHOTOVOLTAIC APPLICATIONS Final Report

P. O. JARVINEN Mar 1982 337 p refs

(Contract DE-AC02-76ET-20279)

(DE82-017128, DOE/ET-20279/159) Avail: NTIS HC A15/MF A01

Efforts to develop a magnetically suspended solar photovoltaic flywheel energy storage unit for residential applications are discussed. A 1/10-scale prototype flywheel unit, which stores 1 kWh of energy in a 400-pound, 15-inch-diameter steel rotor at a maximum of 15,000 RPM, was designed, constructed and tested. The 1/10-scale prototype unit was based on a full-scale, 40-kWh residential flywheel design and was a total system in that it included all the electrical features needed for a complete interface between a photovoltaic array and a residential or utility load. Design features

of the unit, such as its magnetic bearing, motor-generator, rotor and output power-conditioning equipment, are described and test results are presented. Manufacturing cost studies of the full-scale, 40-kWh residential flywheel system are reported along with user worth studies of flywheel systems in the Northeast and Southwest. The 1/10-scale prototype test setup was modified into an advanced prototype flywheel test unit DOE

N83-27445# Houston Univ., Tex Dept of Mechanical Engineering.

ANALYSIS, DESIGN, FABRICATION, AND TESTING OF MODERATELY CONCENTRATING SOLAR-ENERGY COLLECTORS Final Report, Jun. 1976 - Dec. 1979

R. B BANNEROT Nov 1982 115 p refs

(Contract DE-AS05-76CS-35100, E(40-1)-5100)

(DE83-006065; DOE/CS-35100/T1) Avail NTIS HC A06/MF A01

Several topics related to the analysis, design and fabrication of trough like concentrations with flat reflectors are presented. An analytical design concept to help identify optimal optical designs is presented. A computer simulation which performs detailed analyses of given designs is described. Basic heat transfer studies were performed to develop a better understanding of the natural convection mechanisms in specific geometries related to the collectors, namely long, groove like shapes and annular regions DOE

N83-27446# Sandia Labs., Albuquerque, N. Mex Solar Systems Applications Div

EXPERIMENTAL RESULTS OF PITCHING MOMENT TESTS ON PARABOLIC-TROUGH SOLAR-COLLECTOR ARRAY CONFIGURATIONS

D. E. RANDALL, R. E. TATE, and D. A. POWERS Dec. 1982 28 p refs

(Contract DE-AC04-76DP-00789)

(DE83-006027; SAND-82-1569) Avail NTIS HC A03/MF A01

Two wind-tunnel tests were conducted to investigate specifically the pitching moment characteristics of parabolic-trough solar-collector modules deployed within a collector array. The collector modules were located within various rows of a simulated array configuration to investigate shielding effects from upstream collector rows and/or wind-screen fences. Selected fence configurations and fence spacing upstream from the initial array row were studied. The test results demonstrate that pitching moment is significantly reduced by shielding provided by upstream fencing or collector rows DOE

N83-27448# Los Alamos Scientific Lab., N. Mex

ASSESSMENT OF WATER USE IMPACTS FROM SOLAR-ENERGY DEVELOPMENT

Mar 1982 25 p refs

(Contract W-7405-ENG-36)

(DE83-004888; LA-S-482-2) Avail NTIS HC A02/MF A01

It is found that solar energy technologies could represent a slight water savings over the displaced conventional technologies, particularly in the east, however, the projected water saving is on the order of several tenths of a percent of total projected water consumption by the end of the century. The potential does exist for certain localized impacts where concentrations of solar collectors are sited and consume large but periodic quantities of water (for washing the collector surfaces and recharging the primary coolant loop) for municipal supply systems. This could result in seasonal problems in the municipalities where water supply systems are stressed or subject to periodic shortages. DOE

N83-27452# Rockwell International Corp., Canoga Park, Calif. Energy Technology Engineering Center.

AN OVERVIEW OF THE SOLAR IN FEDERAL BUILDINGS DEMONSTRATION PROGRAM (SFBP)

O. R. HILLIG and P. J. PEKRUL 1983 34 p refs Presented at the DOE Workshop on Performance Monitoring of Active Solar Energy Systems, Cape Canaveral, Fla., 20-21 Jan. 1983

(Contract DE-AC03-76SF-00700)

(DE83-005757; CONF-830124-1) Avail: NTIS HC A03/MF A01

The program objectives, project mix and location, and project status are reviewed. The primary technical activities are described: site surveys, design reviews, cost approvals, acceptance testing, and long term monitoring. DOE

N83-27454# Boeing Computer Services, Inc., Seattle, Wash.

INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT FOR G. N. WILCOX HOSPITAL, KAUAI, HAWAII FOR SEPTEMBER 1982, VOLUME 5

Jan. 1983 28 p

(Contract DE-AC04-76DP-00789)

(DE83-006843; SAND-81-7080/5) Avail: NTIS HC A03/MF A01

The data accumulated during September 1982 at the intermediate photovoltaic project at G. N. Wilcox Memorial Hospital, Kauai, Hawaii are presented. Generated energy and environmental data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-27456# Colorado State Univ., Fort Collins. Solar Energy Applications Lab

HOW TO SOLVE MATERIALS AND DESIGN PROBLEMS IN SOLAR HEATING AND COOLING, ENERGY TECHNOLOGY REVIEW NO. 77

D. S. WARD, H. S. OBEROI, and S. D. WEINSTEIN (The Ehrenkrantz Group) 1982 317 p refs

(DE83-006116; DOE/NBM-3006116) Avail: NTIS HC A14/MF A01

Difficulties encountered in active and passive solar space heating systems and active solar space cooling systems are reported. The problems include design errors, installation mistakes, inadequate durability of materials, unacceptable reliability of components, and wide variations in performance of operation of different solar systems. Feedback from designers and manufacturers involved in the solar market is summarized. The designers' experiences with and criticisms of solar components are presented, followed by the manufacturers' replies to the various problems encountered. Information is presented on the performance and operation of solar heating and cooling systems to enable future designs to maximize performance and eliminate costly errors. DOE

N83-27457# Hahn-Jackson-Thresher-Henning, Inc., Evansville, Ind.

SOLAR-ASSISTED WATER-SOURCE HEAT PUMP Final Report

10 Jan 1983 62 p

(Contract DE-FG02-81R5-10298)

(DE83-006023; DOE/R5-10298/T2) Avail: NTIS HC A04/MF A01

The construction of two solar assisted water source heat pump systems to evaluate the use of night sky radiation using standard solar collectors is reported. The design of the system's controller is described, and project efforts are summarized. The procedure involved in the determination of the feasibility of night sky radiation as the means of rejecting heat through solar collectors for a sample house is reported. Conclusions on different types of coatings that are used on solar collectors are presented. A system and its backup are designed and cooling tower and night sky radiation are compared. DOE

N83-27528# Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)

CONCENTRATED SOLAR-FLUX MEASUREMENTS AT THE IEA-SSPS SOLAR-CENTRAL-RECEIVER POWER PLANT, TABERNAS - LAMERIA (SPAIN) Final Report

G. VONTOBEL, C. SCHELDERS, and M. REAL 1982 176 p refs

(Contract DE-AC04-76DP-00789)

(DE82-020000; DOE/NBM-202000, TR-2/82) Avail: NTIS HC A09/MF A01

A flux analyzing system (F.A.S.) was installed at the central receiver system of the SSPS project to determine the relative flux distribution of the heliostat field and to measure the entire optical solar flux reflected from the heliostat field into the receiver cavity. The functional principles of the F.A.S. are described. The raw data and the evaluation of the measurements of the entire heliostat field are given, and an approach to determine the actual fluxes which hit the receiver tube bundle is presented. A method is described to qualify the performance of each heliostat using a computer code. The data of the measurements of the direct radiation are presented. DOE

N83-28071*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A NEW STRATEGY FOR EFFICIENT SOLAR ENERGY CONVERSION: PARALLEL-PROCESSING WITH SURFACE PLASMONS

L. M. ANDERSON 1982 16 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8-13 Aug. 1982, sponsored by IEEE

(NASA-TM-82867, NE-1236, NAS 1.15:82867) Avail: NTIS HC A02/MF A01 CSCL 10A

This paper introduces an advanced concept for direct conversion of sunlight to electricity, which aims at high efficiency by tailoring the conversion process to separate energy bands within the broad solar spectrum. The objective is to obtain a high level of spectrum-splitting without sequential losses or unique materials for each frequency band. In this concept, sunlight excites a spectrum of surface plasma waves which are processed in parallel on the same metal film. The surface plasmons transport energy to an array of metal-barrier-semiconductor diodes, where energy is extracted by inelastic tunneling. Diodes are tuned to different frequency bands by selecting the operating voltage and geometry, but all diodes share the same materials. Author

N83-28128# Los Alamos Scientific Lab., N. Mex.

USE OF OXIDES IN THERMOCHEMICAL WATER-SPLITTING CYCLES FOR SOLAR HEAT SOURCES. COBALT OXIDES

W. M. JONES and M. G. BOWMAN 1982 7 p refs Presented at World Hydrol. Energy Conf., Pasadena, Calif., 13 Jun. 1982

(Contract W-7405-ENG-36)

(DE82-011977, LA-UR-82-584; CONF-820605-15) Avail: NTIS HC A02/MF A01

The concept of utilizing oxide decompositions in advanced thermochemical hydrogen cycles for solar heat sources is introduced. It has particular interest in allowing direct transmission of energy to the process through an air window. A cycle for the Co₃O₄-CoO pair would, schematically: (1) Co₃O₄ = 3CoO + 1/2 O₂; (2) I₂(s,1) + Mg(OH)₂ + 3CoO = MgI₂(aq) + Co₃O₄ + H₂O (1), (3) H₂O + MgI₂(aq) = MgO + 2HI; (4) 2 HI = H₂ + I₂; and (5) MgO + H₂O = Mg(OH)₂. Reaction (2) should give a high concentration of MgI₂ that would be favorable for (3). The solutions would also contain iodine dissolved as polyiodide, partly offsetting this advantage. Preliminary results indicate that reaction (2) is slow at 150 deg O₂ (4); and Mg. It is surmised that the mechanism of (2) consists of the iodine disproportionation reaction (6), followed by reaction (7): (6) I₂(s,1) + Mg(OH)₂ = 5/6 MgI₂(aq) + 1/6 Mg(IO₃)₂(aq) + H₂O(1); and (7) 1/6 Mg(IO₃)₂(aq) + 3 CoO = 1/6 MgI₂(aq) + Co₃O₄. DOE

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N83-28286# California Univ., Berkeley. Lawrence Berkeley Lab.

INFILTRATION AND INDOOR AIR QUALITY IN A SAMPLE OF PASSIVE-SOLAR AND SUPER-INSULATED HOUSES

B. S. WAGNER and A. H. ROSENFELD Jun 1982 7 p refs
Presented at 7th Natl Passive Solar Conf., Knoxville, Tenn, 29 Aug 1982

(Contract W-7405-ENG-48)

(DE82-018516; LBL-14111, CONF-820819-8) Avail: NTIS HC A02/MF A01

Infiltration rates and indoor air quality were measured in 16 solar and super insulated houses in California. In this area careful construction can, at reasonable cost, reduce infiltration to 0.2 to 0.5 air changes per hour (40 to 100 min). To evaluate possible indoor air quality problems at these low infiltration rates, levels of three pollutants were monitored in early 1982 during weather cold enough to encourage occupants to keep their windows closed. No₂, formaldehyde, and radon were measured using inexpensive, passive monitors. The blower door infiltration measurements are described and relationships between relevant building and occupant characteristics and observed levels of pollutants are discussed. These levels are also compared to current standards. Implications for housing design and construction techniques are discussed, and further research needs are suggested. DOE

N83-28287# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst

PERFORMANCE RESULTS FROM PASSIVE-SOLAR RESIDENCES IN DENVER, COLORADO

J. N. SWISHER 1982 7 p refs

(Contract DE-AC02-77CH-00178)

(DE82-019126; SERI/TP-254-1644) Avail: NTIS HC A02/MF A01

The thermal performance of six passive solar residences in the Denver, Colorado metropolitan area is discussed. These buildings were monitored. A low cost approach to building thermal monitoring is explained, including the instrumentation hardware, the real time data reduction program, and the performance evaluation methodology. The buildings are described in detail, with monthly and seasonal summaries of weather data and the basic building energy flows. Detailed analysis efforts, using hourly data, are discussed briefly. DOE

N83-28345# Midwest Research Inst., Golden, Colo. Building Systems Research Branch.

ANALYSIS OF ON-SITE USE AND SELBACK IN RESIDENTIAL PHOTOVOLTAIC SYSTEMS

S. SILLMAN Apr. 1982 64 p refs

(Contract DE-AC02-77CH-00178, EG-77-C-01-4042)

(DE82-012697; SERI/TR-254-1444) Avail: NTIS HC A04/MF A01

One promising early use of photovoltaics is grid connected residential systems without batteries. In these systems, photovoltaic power is used onsite as much as possible, and the remainder is sold back to the utility. The amount of direct on-site use versus sellback of photovoltaic power depends on the instantaneous load patterns. A method is developed for characterizing the instantaneous load based on the on/off probabilities of individual appliances. A monthly step simulation method based on the instantaneous load characterization is presented and verified. Simulations are performed for several residential load mixes, including the use of energy efficient appliances and passive solar design. Results show that on-site use of photovoltaic power is much less, and sellback much more, than previous results indicated for single family residences. Even small systems are found to sell back 50% or more of generated power to the utility. DOE

N83-28360 Purdue Univ., Lafayette, Ind

CONVECTIVE HEAT TRANSFER IN LOUVERED SOLAR COLLECTORS Ph.D. Thesis

D M CHRISTOPHER 1982 219 p

Avail: Univ Microfilms Order No. DA8225698

A family of air-heating solar collectors having a louvered absorber-convector was analyzed experimentally and theoretically for normal ranges of design and operating conditions. The first theoretical model is based on an algebraic formulation of the conversion equations. It accounts for conduction, convection, and thermal and solar band radiation exchange. The second theoretical model is a differential formulation and numerical solution of the two dimensional conservation equations. The analysis includes variable properties, buoyancy, and radiative transfer between surfaces. The multiply-connected computational region lies between the lower cover plate and the backplate and contains the absorber, which is made of overlapping, opaque louvers. The experimental and differential models are used to determine the convective heat transfer coefficient along the louver surfaces. The thermal efficiency of the louvered collector is determined from the experimental results and from the algebraic model. Parametric studies are performed to determine the effects that collector and louver geometry and several operating parameters have on the louver Nusselt number and the collector thermal efficiency. Dissert. Abstr.

N83-28573* National Aeronautics and Space Administration Langley Research Center, Hampton, Va

SOLAR DRIVEN LIQUID METAL MHD POWER GENERATOR Patent

J. H. LEE (Vanderbilt Univ., Nashville, Tenn.) and F. HOHL, inventors (to NASA) (Vanderbilt Univ., Nashville) 14 Jun 1983 7 p. Filed 15 May 1981. Supersedes N81-32609 (19 - 23, p 3215). Sponsored by NASA.

(NASA-CASE-LAR-12495-1; US-PATENT-4,388,542,

US-PATENT-APPL-SN-263830; US-PATENT-CLASS-310-11)

Avail: US Patent and Trademark Office CSCL 10A

A solar energy collector focuses solar energy onto a solar oven which is attached to a mixer which in turn is attached to the channel of a MHD generator. Gas enters the oven and a liquid metal enters the mixer. The gas/liquid metal mixture is heated by the collected solar energy and moves through the MHD generator thereby generating electrical power. The mixture is then separated and recycled.

Official Gazette of the U.S. Patent and Trademark Office

N83-28578 Mississippi State Univ., State College.

SURFACE INFLUENCES ON THE CHARACTERISTIC PERFORMANCE OF THE SALT GRADIENT SOLAR POND. AN EXPERIMENTAL STUDY Ph.D. Thesis

C. O. ONWUBIKO 1982 177 p

Avail: Univ. Microfilms Order No. DA8227553

The success of the Solar Pond as a device for collecting and storing solar energy depends on, among other factors, the maintenance of a stable density gradient above the storage zone. The effects of evaporation and surface temperature variations on the performance of the pond were studied. Two laboratory solar ponds were used so as to easily control these factors. The effect of evaporation was studied by suppressing evaporation in one of the ponds. The surface temperature was varied from 55 F to 37 F. Horizontal temperature variations were also investigated. An equation for predicting the temperature difference between covered and uncovered ponds in this storage zone was developed. In order to have a basis for comparison of the experimental results, a two-dimensional heat conduction model was formulated for the nonconventional zone and its solution was obtained by a finite difference technique. A one-dimensional model that was previously developed was also used for the purpose of comparison. In both models, there was close agreement between the experimental results and the prediction of the mathematical models.

Dissert. Abstr.

N83-28579 Colorado State Univ., Fort Collins.
COST AND PERFORMANCE EVALUATION OF TERRESTRIAL SOLAR THERMAL POWER SYSTEMS Ph.D. Thesis
 N. ELGABALAWI 1982 367 p
 Avail: Univ Microfilms Order No DA8227917

A cost optimization model was developed based on relating systems costs to performance and minimizing the system electric energy production costs. The model was applied to systems representing major categories of solar thermal power systems such as the central receiver, the parabolic dish, the line-focusing and the fixed orientation focusing collectors. Several types of engines and energy storage systems were included in the analysis. Energy cost comparisons and sensitivities to system cost and performance parameters were analyzed for several plant sizes. A dynamic simulation model was also developed for the parabolic dish-Brayton system based on detailed system performance analysis and subsystem interfaces. The model was used to establish the system's performance characteristics over a wide range of insulations, engine speeds and temperatures. System performance variations due to the effect of reflector surface accuracy and receiver aperture as well as ambient conditions were included in the study. Transient performance and system response to large variations in insolation were also investigated for the development of stable feedback control systems. Dissert. Abstr

N83-28585# Army Construction Engineering Research Lab., Champaign, Ill. Energy Systems Div
SOLFEAS: AN INTERACTIVE PROGRAM FOR ESTIMATING THE ECONOMIC FEASIBILITY OF AN ACTIVE SOLAR THERMAL ENERGY SYSTEM Final Report
 D M. JONCICH and C W. SOHN Jan 1983 72 p refs
 (Contract DA PROJ 4A7-62781-AT-45)
 (AD-A125682, CERL-TR-E-180) Avail NTIS HC A04/MF A01
 CSCI 09B

SOLFEAS is an interactive computer program developed to provide Corps of Engineers Field Operating Agencies (FOAs) with a simple, inexpensive means of estimating the economic feasibility of an active solar thermal energy system. SOLFEAS can project paybacks for each of four solar system types: (1) service water heating/preheating (domestic hot water and/or process hot water), (2) space heating only, (3) combined space - service water heating, and (4) combined space service water heating/space cooling.

Author (GRA)

N83-28623# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst
ADVANCED, HIGH-TEMPERATURE MOLTEN SALT STORAGE
 R. J. COPELAND /In Courtesy Assoc., Inc. Proc of the DOE Phys. and Chem. Storage Ann Contractors' Rev. Meeting p 300-305 Dec. 1982 refs
 Avail: NTIS HC A25/MF A01

Advanced molten salts (hydroxides, carbonates, and chlorides) are being researched for solar thermal applications. These salts may be used in both the receiver working fluid and in thermal energy storage. Potential applications include electric power production, fuel and chemical production, and high temperature process heat. Molten salts can store sensible heat at temperatures up to 1100 C in a thermocline system with a unique insulating platform (raft) that floats between the hot and cold molten salts. Overall solar thermal and thermal storage systems are described, and the economic potential of the systems are assessed. The performance of insulating raft thermocline are being tested and materials compatibility are studied. S.L.

N83-28628# Argonne National Lab., Ill.
STRATIFIED STORAGE MEASUREMENT AND ANALYSIS
 R. L. COLE /In Courtesy Assoc., Inc. Proc of the DOE Phys. and Chem. Storage Ann Contractors' Rev. Meeting p 405-409 Dec. 1982 refs
 Avail NTIS HC A25/MF A01

Water tanks operated at low temperatures (0 to 15 C) are more difficult to stratify because water's coefficient of thermal expansion beta is small in that temperature range and it changes

sign at 4 C. Research has shown that stratification can improve the performance of solar systems by as much as 20%. It is shown that the Richardson number is the most important parameter governing thermal stratification. For Richardson numbers less than the critical value of 0.25 mixing occurs, but for Richardson number greater than 0.25 stratification is possible. S.L.

N83-28635# Stanford Univ., Calif. Dept of Mechanical Engineering
DEVELOPMENT OF A PREDICTIVE COMPUTER CODE FOR HEAT LOSSES FROM SOLAR EXTERNAL RECEIVERS
 B AFSHARI and J H. FERZIGER Feb 1983 48 p refs
 (Contract DE-AC04-76DP-00789)
 (DE83-007310, SAND-82-8183) Avail. NTIS HC A03/MF A01

Mixed convection from external receivers is considered. The governing partial differential equations are stated, and the numerical solution is obtained by Keller's box method. The computer code developed to predict the heat losses in the attached flow region is described. Special attention is given to treatment of some numerical difficulties. Preliminary computational results for laminar three dimensional mixed convection are presented. Future project efforts and planned extensions of the present code are described. DOE

N83-28636# California Univ., Livermore. Lawrence Livermore Lab.
SOLAR-THERMAL DECOMPOSITION OF ZINC SULFATE
 P K SHELL, R. RUIZ, and C. M. YU Jan. 1983 35 p refs
 (Contract W-7405-ENG-48)
 (DE83-007461, UCRL-53370) Avail NTIS HC A03/MF A01

Experimental decomposition of zinc sulfate in a rotary kiln which was heated in the White Sands Solar Furnace is described. The main findings are the zinc sulfate sulfate decomposed after 1 to 5 minutes of solar exposure when the front thermocouple indicated 7000 C and kiln was being rapidly heated with a flux of 9 to 14 kW, or the front thermocouple was above 8500 C and the kiln was maintained at temperature with a minimal flux. It is found that there is a problem with zinc sulfate agglomeration above approximately 8000 C. The agglomeration problem interfered significantly with testing, and it prevented the acquisition of quantitative data on the rate and extent of zinc sulfate decomposition. The agglomeration problem solved either by physically breaking apart the agglomerate by chains or by mixing inert compounds with the zinc sulfate to prevent the particles from sticking to each other. The rotary kiln performed satisfactorily and there were no problems with the window. DOE

N83-28639# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif
THE 10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT: SOLAR FACILITIES DESIGN INTEGRATION. PILOT-PLANT STATION MANUAL (RADL ITEM 2-1). VOLUME 1: SYSTEM DESCRIPTION
 Sep 1982 629 p
 (Contract DE-AC03-79SF-10499)
 (DE83-001667; MDC-G-8544-VOL-1; SAN-0499-57-VOL-1) Avail: NTIS HC A99/MF A01

The complete Barstow Solar Pilot Plant is described. The plant requirements and general description are presented, the mechanical, electric power, and control and instrumentation systems as well as civil engineering and structural aspects and the station buildings are described. Included in the mechanical systems are the heliostats, receiver, thermal storage system, beam characterization system, steam, water, nitrogen, and compressed air systems, chemical feed system, fire protection system, drains, sumps and the waste disposal systems, and heating, ventilating, and air conditioning systems. DOE

02 SOLAR ENERGY

N83-28640# Tennessee Valley Authority, Chattanooga. Div of Energy Conservation and Rates.

NASHVILLE SOLAR-WATER-HEATER DEMONSTRATION PROJECT. MONITORING-DATA ANALYSIS Interim Report, Sep. - Nov. 1981

Mar 1982 60 p refs

(DE83-900173, TVA/OP/ECR-82/39(9-11)) Avail: NTIS HC A04/MF A01

Field monitoring data which were collected for the Nashville Solar Water Heater Demonstration Project from September through November of 1981 are presented. Twenty-six solar domestic water heaters were monitored during September, 35 during October, and 37 during November. Homeowners were audited to assure adequate solar access, and each selected a solar water heating system from an approved list. Two tank and one tank systems are included. The monitoring sample technique and monitoring system are described. Data are analyzed by computer to produce daily and monthly total summaries for each site. The performance of each site was assessed to compare total energy saved by the solar system, solar system savings percentage, and the energy multiplier. DOE

N83-28643# Solar Energy Industries Association, Washington, D.C.

SOLAR-THERMAL-PROGRAM STRATEGY

Jan 1983 36 p

(Contract DE-AC04-82AL-19929)

(DE83-006997; DOE/AL-19929/T1) Avail: NTIS HC A03/MF A01

The status of the solar thermal industry, including companies developing parabolic dish, parabolic trough, and central receiver systems was reviewed and the industry's strategy is assessed. Strategic targets are in the utility and industrial sectors. The approaches of the Carter and Reagan Administrations are compared. A case is made against cutting off funding at the present time. DOE

N83-28648# California Univ., Berkeley. Lawrence Berkeley Lab Energy and Environment Div

SOLAR ENERGY PROGRAM, FY 1981 Annual Report

Sep. 1982 34 p refs

(Contract DE-AC03-76SF-00098)

(DE83-006955; LBL-13496) Avail: NTIS HC A03/MF A01

Passive research and development, active solar cooling, appropriate energy technology, energy conversion by the retinal protein. Bacteriorhodopsin, measurement and analysis of circumsolar radiation, support for SOLERAS solar cooling engineering field tests, LBL building 71 solar cooling project, development of a 30-kW high temperature solar receiver using small particles as the heat exchanger, and diffractive solar collection systems.

N83-28650# California Univ., Berkeley. Lawrence Berkeley Lab.

ACTIVE SOLAR COOLING

M. A. WAHLIG, K. DAO, M. L. WARREN, J. E. RASSON, R. A. ARMER, H. ANGERMAN (Keller and Gannon), and A. HEITZ (Keller and Gannon) *In its* Solar Energy Program, FY 1981 9 p Sep 1982 refs

Avail: NTIS HC A03/MF A01

The single-effect chiller was tested and evaluated. Cost goal methodology, system and subsystem costs, and controls test facility and analysis are presented. Technical support activities are also reported. Author

N83-28653# California Univ., Berkeley. Lawrence Berkeley Lab.

LBL BUILDING 71 SOLAR COOLING PROJECT

F. H. SALTER *In its* Solar Energy Program, FY 1981 1 p Sep. 1982

Avail: NTIS HC A03/MF A01

The purposes of this program are to demonstrate the Federal Government's confidence in the solar industry and to stimulate

growth and technical improvements in solar technology through the installation and demonstration of a variety of commercially applicable solar energy systems in buildings owned or occupied by the Federal Government. Author

N83-28654# California Univ., Berkeley. Lawrence Berkeley Lab.

DEVELOPMENT OF A 30-KW HIGH TEMPERATURE SOLAR RECEIVER USING SMALL PARTICLES AS THE HEAT EXCHANGER

A. J. HUNT, M. DEIRINGER, D. B. EVANS, L. HANSEN, P. G. HULL, and D. PAYDARFAR *In its* Solar Energy Program, FY 1981 3 p Sep 1982 refs

Avail: NTIS HC A03/MF A01

The purpose of this work is to develop a new type of solar thermal receiver that utilizes concentrated sunlight to heat a gas to high temperature to operate a turbogenerator or to supply industrial process heat. The Small Particle Heat Exchange Receiver (SPHER) uses a very small mass of ultrafine carbon particles suspended in a gas to absorb sunlight and transfer the heat to the gas. The concentrated sunlight, provided by a parabolic dish or system of mirrors, passes through a window into a chamber containing the absorbing suspension. Because the energies are very small, they are not significantly affected by gravitational or inertial forces, they are effectively part of the gas. Author

N83-28655# California Univ., Berkeley. Lawrence Berkeley Lab.

DIFFRACTIVE SOLAR COLLECTION SYSTEMS

D. B. EVANS and A. J. HUNT *In its* Solar Energy Program, FY 1981 3 p Sep. 1982 refs

Avail: NTIS HC A03/MF A01

The purpose of this project is to investigate solar collector systems based on the diffraction of light. Present solar collection systems rely on reflection or refraction of sunlight. The technique proposed here is based on the use of diffractive optics, in particular Holographic Optical Elements (HCE's), to intercept sunlight and diffract it toward an energy conversion or storage device (e.g., photovoltaic cell, solar thermal receiver, or thermal mass). Author

N83-28660# Los Alamos Scientific Lab., N. Mex.
ECONOMIC PROFILES OF SELECTED SOLAR-ENERGY TECHNOLOGIES FOR USE IN INPUT-OUTPUT ANALYSIS

G. S. MANN and B. F. NEENAN May 1982 98 p refs

(Contract W-7405-ENG-36)

(DE82-016741, LA-9083-TASE) Avail: NTIS HC A05/MF A01

A methodology for preparing cost profiles of prototype, nonconventional energy technologies for use with economic input/output analysis is presented. The application of the costing methodology is represented where economic profiles are presented for 12 solar energy related technologies. The development of a practical, theoretical framework that yields the most suitable configuration of the technology cost profiles is outlined. Characterization and emerging technology to assess industry related impacts caused by its potential future application by using an input/output model of the economy are discussed. The theoretical problem is of specifying an emerging, but currently nonexistent, industrial sector within an existing economic matrix. It is shown how consistent economic profiles can be built up from the engineering specifying an emerging, but currently nonexistent, industrial sector within an existing economic matrix. It is shown how consistent economic profiles can be built up from the engineering specifications of a prototype energy conversion system. DOE

N83-28661# Los Alamos Scientific Lab., N. Mex. Economics Group.

IMPACT OF SOLAR-ENERGY DEVELOPMENT. THE AGGREGATE IMPACT ON BASIC ECONOMIC OBJECTIVES

A. PARKER (New Mexico Univ., Albuquerque), C. KIRSCHNER (New Mexico Univ., Albuquerque), and F. ROACH 1982 7 p refs Presented at Am Section of the Intern. Solar Energy Soc. Conf., Houston, Tex., 1 Jun. 1982 (Contract W-7405-ENG-36) (DE82-012151, LA-UR-82-871; CONF-820629-2) Avail: NTIS HC A02/MF A01

Two categories of incentives for the development of solar energy are described: those that increase the benefits associated with the ownership of a solar energy system and those that reduce the cost of the system. The impact of two alternative programs are presented. Short run and long run impacts expected to result from the installation of passive solar designs on existing housing rock are distinguished. Impacts associated with a program to deregulate natural gas and one combining tax credits and low interest loans are compared. The impacts of solar programs on seven basic economic goals are analyzed. The goals are full employment, price stability, economic efficiency, equitable distribution of income, economic growth, balancing the federal budget, and a strong national defense. DOE

N83-28662# California Univ., Berkeley. Lawrence Berkeley Lab.

COST AND PERFORMANCE GOAL METHODOLOGY FOR ACTIVE SOLAR-COOLING SYSTEMS

M. L. WARREN and M. WAHLIG Feb. 1982 83 p refs (Contract W-7405-ENG-48) (DE82-009842; LBL-12753) Avail: NTIS HC A05/MF A01

Economic and thermal performance analyses of typical residential and commercial active solar cooling systems are used to determine cost goals for systems to be installed between the years 1986 and 2000. Market studies indicate a relationship between market penetration (percent of market captured) and payback period for heating, ventilating, and air conditioning systems. Using reasonable values for fuel escalation and inflation rates, the payback period is related to the expected real return on investment. Postulating commercial introduction of solar cooling systems in 1986 with the market share increasing to 20% by the year 2000, payback and return on investment goals for cooling systems as a function of year of purchase are established. Using the results of systems analysis of representative 3 ton solar residential cooling/heating systems and 25 ton commercial solar cooling systems for four different cities (Ft. Worth, Phoenix, Miami, and Washington, DC), the return on investment goals are used to calculate the 20 year present value of energy savings of the solar energy systems. DOE

N83-28663# Rockwell International Corp., Golden, Colo. Energy Systems Group.

ADVANCED CONCEPTUAL DESIGN OF THE SOLAR-REPOWERING SYSTEM FOR WEST TEXAS UTILITIES COMPANY, PAINT CREEK POWER STATION UNIT NO. 4 Final Report

7 May 1982 443 p refs (Contract DE-AC03-81SF-11569) (DE82-014606; ESG-DOE-13387) Avail: NTIS HC A19/MF A01

The results of the conceptual design study reported include the development of a workable design for a sodium-cooled tower focus repowering system, the costs required to construct that design, and the determination of the benefits which could be obtained. A number of trade studies and optimizations were carried out in order to derive the most cost-effective design that also had the greatest potential for widespread application and commercialization. These studies are identified and their results are presented and discussed. The overall plant design is described and diagrammed, as are each of the subsystems: the heliostats, external receiver, master control, heat transport, thermal storage, electric power generating, and steam generating subsystems. Each subsystem's cost is summarized by major component. The

subsystem is then described with its major components in terms of physical characteristics, requirements, and performance. DOE

N83-28665# Neomathics, Inc., Cambridge, Mass
AN INTEGRATED PLANNING STRUCTURE FOR COMMERCIAL APPLICATIONS OF ACTIVE SOLAR COOLING: METHODOLOGY AND ANALYSIS Final Report

May 1982 133 p refs (Contract DE-AC03-81CS-30571) (DE82-016645, DOE/CS-30571/T2) Avail: NTIS HC A07/MF A01

The likely market for solar cooling is evaluated within an integrated planning framework. A major objective is to develop the set of tools that are needed to determine performance and cost targets that will make solar cooling cost-effective in a given time frame. Cooling needs and solar cooling's possible role in fulfilling those needs are reviewed. The commercial market is isolated as the one with the greatest potential for using solar cooling. The theory and application of market modeling in the industrial/commercial sector are reviewed in detail. Adoption and market penetration models are discussed and reviewed and the results of studies of the solar market place are presented. The philosophy followed is that no one knows the future exactly; therefore, the best we can do is develop methodology that can project, under various scenarios, what is most likely to happen. The assumptions that go into that analysis and the development of the appropriate tools are discussed in detail. DOE

N83-28671# Brookhaven National Lab., Upton, N. Y.
HEATING-SEASON THERMAL PERFORMANCE OF THE BROOKHAVEN HOUSE

H. T. GHAFARI and R. F. JONES 1982 7 p refs Presented at the American Sect. of the Intern. Solar Energy Soc. Renewable Challenge Conf. and Exhibition, Houston, Tex., 1-5 Jun. 1982 (Contract DE-AC02-76CH-00016) (DE82-015808; BNL-31268; CONF-820629-11) Avail: NTIS HC A02/MF A01

In the Brookhaven Natural Thermal Storage House, a superinsulated envelope, passive solar collectors, and a variety of energy conservation methods are utilized. The thermal performance of the house is evaluated from the data acquired during the 80-81 heating season. The thermal exchange relating to heat loss and gain from the living spaces passive solar contributions, and the thermal storage of the structure are identified and quantified. Several thermal performance ratios and correlation factors are introduced. The average diurnal characteristics of these parameters are then tabulated, and their monthly average hourly values are plotted. Finally, the overall seasonal factors are identified and analyzed. DOE

N83-28687# Barry (Theodore) and Associates, Los Angeles, Calif.

PHOTOVOLTAIC SUBSYSTEM PRODUCTION COST MODEL (SAMIS) Final Report

Jul. 1982 51 p refs Prepared for Sandia Labs., Albuquerque, N. Mex. (Contract DE-AC04-76DP-00789) (DE82-018192; SAND-81-7049) Avail: NTIS HC A04/MF A01

A complete introduction to the SAMIS model is provided. The purpose of the model is to estimate the costs of manufacturing photovoltaic solar energy products. The model procedure for estimating the long run or steady-state manufacturing cost is divided into four submodels: manufacturing process submodel, factory construction and staffing algorithm, capital requirements submodel, and the financial model of the firm. The model has been applied by Sandia National Laboratories for DOE's National Photovoltaics Program to assess the commercial viability of new solar energy manufacturing processes. However, given the proper input data, the model structure is flexible enough to support the design and analysis of any manufacturing industry. This document explains what the model can and cannot do, and what data is required. An example for a photovoltaic power conditioning unit demonstrates the application of the model. DOE

N83-28694# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

SOLERAS SOLAR-ENERGY CONTROLLED-ENVIRONMENT AGRICULTURE PROJECT

W. LUFT, J. FROECHTENIGT, and A. FALATAH May 1982 7 p refs Presented at the 17th Intersoc Energy Conversion Eng. Conf., Los Angeles, 8 Aug. 1982 (Contract DE-AC02-77CH-00178) (DE82-014266; SERI/TP-270-1588; CONF-820814-1) Avail: NTIS HC A02/MF A01

Three commercial size (5-ha), solar powered, controlled environment agriculture systems for hot, dry climates are described. The systems use brackish well water for cooling. The well water is desalinated for irrigation using reverse osmosis. Produce output ranges from 44 to 78 kg square m yr with an overall water consumption of 8 to 139 L/kg produce and electric energy consumption of 111 to 790 Wh/kg produce. The levelized cost ranges from \$1.14 to \$8.07 per kg of produce. DOE

N83-28695# Sandia Labs., Albuquerque, N. Mex. Solar Energy Projects Dept.

VARIATION OF COLLECTOR EFFICIENCY AND RECEIVER THERMAL LOSS AS A FUNCTION OF SOLAR IRRADIANCE

V. E. DUDLEY (EG&G, Inc.) and R. M. WORKHOVEN 1982 13 p refs Presented at the ASME Solar Energy Conf., Albuquerque, N. Mex., 26 Apr. 1982 (Contract DE-AC04-76DP-00789) (DE82-006942; SAND-82-0163C; CONF-820410-5) Avail: NTIS HC A02/MF A01

Efficiency and thermal loss of a parabolic trough concentrating solar collector have been measured for values of solar irradiance between 400 W/sq m and 100 W/sq m. Both parameters are shown to vary significantly with changing solar irradiance. Significant errors can result from improper use of currently published efficiency data. DOE

N83-28696# Sandia Labs., Albuquerque, N. Mex. Thermophysical Properties Div.

OPTICAL MODELING OF BLACK CHROME SOLAR-SELECTIVE COATINGS

J. N. SWEET and R. B. PETTIT Jul. 1982 120 p refs (Contract DE-AC04-76DP-00789) (DE82-018576; SAND-82-0964) Avail: NTIS HC A06/MF A01

Various investigations of coating microstructure are reviewed and the results of these studies are used to develop a picture of the microstructure of the black chrome films plated from the Harshaw Chromonyx bath. In this model, the black chrome film is composed of roughly spherical particles which may tend to cluster together. These particles in turn are composed of small crystallites of metallic chrome and various oxides of chrome. The film void volume fraction appears to be or = 0.6. The microstructural picture has been idealized to facilitate calculations of the spectral reflectance for films deposited onto nickel substrates and for freestanding or stripped films. In the idealized model, the metallic chromium is assumed to be in the form of spherical crystallites with concentric shells Cr₂O₃ and the crystallite volume fraction is assumed to increase with depth into the film. Various experimental data are utilized to define film thickness, average volume fraction of Cr + Cr₂O₃, and volume ratio of Cr to Cr + Cr₂O₃. DOE

N83-28700# Arizona State Univ., Tempe. School of Engineering.

TERRESTRIAL PHOTOVOLTAIC POWER SYSTEMS WITH SUNLIGHT CONCENTRATION Annual Progress Report, 1980 - 1981

C. E. BACKUS and R. W. SANDERSON May 1982 102 p refs (Contract DE-AC04-76DP-00789) (DE82-017678; DOE/NBM-2017678) Avail: NTIS HC A06/MF A01

Arizona State University's concentrator cell test facility provides a source as a proving ground for concentrator cell test techniques. Test procedures and results obtained at this facility are summarized.

An investigation dealing with both the calibration accuracy of reference cells and the need for matching the spectral response characteristics of the reference cell to the test cell are described. In addition, a technique for predicting short-circuit currents of silicon solar cells under any reference irradiance condition is outlined, with sample theoretical and experimental data included to show the accuracy and repeatability of the technique. An investigation is presented to evaluate the linearity of several concentrator solar cells with irradiance by measuring cell spectral response at various levels of irradiance. Results indicate that the assumed linearity of solar cell short-circuit current is not strictly valid for most concentrator cells. DOE

N83-28707# Argonne National Lab., Ill

DIRECT SOLAR STEAM-GENERATING SYSTEM

J. VRESK 1982 8 p Presented at the 3rd Intern Symp on Energy Conservation in the Built Environ., Dublin, Ireland, 30 Mar 1982

(Contract W-31-109-ENG-38)

(DE83-008661; CONF-830309-6) Avail: NTIS HC A02/MF A01

A new technology that generates steam by the use of solar energy is described. Steam is generated directly in the solar collectors. The advantages of direct solar steam generation are compared with the methods of indirect solar steam generation. Schematics and modes of operation of a demonstration system are presented. Feasibility of the concept, and how to obtain necessary design parameters, was established. The feasibility of direct solar steam generation is shown. This concept is suitable for generating low pressure steam. The major applications are expected to be in process steam, absorption cooling, and steam heating. DOE

N83-28714# New Mexico State Univ., Las Cruces

NEW MEXICO STATE ENERGY RESEARCH AND DEVELOPMENT PROGRAM CONTRIBUTION TO LOVINGTON 100-KILOWATT PHOTOVOLTAIC PROJECT Final Report

V. V. RISSER Jun 1982 20 p (DE82-905248; NP-2905248) Avail: NTIS HC A02/MF A01

In 1977 the New Mexico State Energy Research and Development (R & D) Program provided \$25,000 to the New Mexico Solar Energy Institute to be used in conjunction with US Department of Energy (DOE) funding for design, engineering, and installation of a proposed 150-kilowatt peak photovoltaic (PV) system in Lovington, New Mexico. An additional \$75,000 was also committed contingent on award of a contract for construction, test, and evaluation of the system. This award was made in 1979 and the PV system was completed in 1981. Even though budget constraints dictated reduction of the plant size to 100-kilowatts peak, this system has produced more energy than any other flat-plate PV system in the world. The utilization of the R & D Program funding in contributing to the success of this important New Mexico energy project is detailed. DOE

N83-28716# Drexel Univ., Philadelphia, Pa Dept. of Electrical and Computer Engineering

A FILTERING ALGORITHM FOR ESTIMATING THE FLUID TEMPERATURES IN SOLAR COLLECTORS UNDER FLOW AND STAGNANT CONDITIONS

M. SUGISAKA (Oita Univ., Japan), P. KALATA, and R. FISCHL 1982 15 p refs Presented at the IFAC Conf. on Identification and System Parameter Estimation, Washington, D C., 7 Jan 1982 (Contract DE-AS02-77CS-34512; DE-AS03-86CS-30218) (DE82-017091; CONF-820151-1) Avail: NTIS HC A02/MF A01

A filtering technique is presented for estimating the fluid temperature profile in a solar energy collector modeled by a bilinear distributed-parameter system (the Klein plug-flow model). The filter minimizes the mean-square error between the actual measurements and the states predicted by the model when the fluid flow through the collector is controlled by an on-off pump (bang-bang control). The derivation of the filter algorithm uses invariant imbedding and the method of characteristics. This approach allows one to estimate under bang-bang control situations and has the flexibility to easily vary the sensor locations. As examples, the filtering process is

applied to a simulated solar collector system with a variety number of sensors and many on-off fluid flow control cycles. DOE

N83-28720# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

REVERSIBLE CHEMICAL REACTIONS FOR ENERGY STORAGE IN A LARGE-SCALE HEAT UTILITY

R. G. NIX, P. W. BERGERON, and R. E. WEST (Colorado Univ.) May 1982 7 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8 Aug. 1982 (Contract DE-AC02-77CH-00178) (DE82-015234; SERI/TP-234-1543; CONF-820814-7) Avail: NTIS HC A02/MF A01

The feasibility of using either $\text{Ca}(\text{OH})_2$ or $\text{CH}_2\text{-CO}_2$ reaction systems for long duration storage in a central receiver, solar energy facility was studied. The system is required to generate 262 MW/sub t/ (895 million Btu/h) as 4.14-MPa (600 psig), 400 C (750 F) superheated steam, with usage split evenly among 10 users clustered in an industrial park. Results indicate that use of a solar thermal system with long duration storage of either thermochemical or direct thermal energy (molten draw salt) is probably not justified when compared to the use of coal fired boilers for steam generation. However, solar thermal systems with either thermochemical or direct thermal energy storage may be competitive with oil or natural gas fired boilers if the cost of the solar energy supplied to the storage system is sufficiently low and the costs of oil and natural gas have escalated to a sufficiently high level. DOE

N83-28721# New Mexico State Univ., Las Cruces Dept. of Chemistry.

SOLAR SYNTHETIC FUEL PRODUCTION: HYDROGEN FROM THE SUN Final Report, 1 Jul. 1980 - 31 Aug. 1981

D. D. DAVIS Jun. 1982 36 p refs Sponsored by New Mexico Energy Research and Development Inst. (DE82-017561; NP-2017561) Avail: NTIS HC A03/MF A01

The investigation of the photo-induced electron transfer reactions of polymeric absorbers has shown that several stringent requirements exist for selection of an appropriate back bone polymer. Poly(vinylpyridine), the first of those polymers to be evaluated, does not allow for high degrees of substitution of absorbing centers onto the back-bone, and those that do attach, are both thermally and photochemically labile. A program of synthesis has resulted in several new polymers which have failed to meet the solubility requirement. This synthetic effort is still in force and will operate for the next several years. Concomitantly, the investigation of the electron transfer properties of smaller subunits is proceeding and will eventually mesh with the synthesis program DOE

N83-28722# Los Alamos Scientific Lab., N. Mex.

MONITORED PASSIVE-SOLAR BUILDINGS

R. W. JONES, comp. Jun. 1982 69 p refs (Contract W-7405-ENG-36) (DE82-019715; LA-9098-MS) Avail: NTIS HC A04/MF A01

Selected performance results from six monitored passive and hybrid solar heated buildings are presented. These employ, a two story trombe wall; a thermosyphoning solar air heater with rock bin storage; a greenhouse; a composite concrete and water trombe wall; two story sunspace; and, for a mobile/modular home, direct gain and roof pond DOE

N83-28723# Los Alamos Scientific Lab., N. Mex.

SOLAR HEATING IN THE LOS ALAMOS MOBILE/MODULAR HOME UNIT NO. 1

J. C. HEDSTROM and S. W. MOORE Apr. 1982 66 p refs (Contract W-7405-ENG-36) (DE82-016136; LA-9299-MS) Avail: NTIS HC A04/MF A01

Mobile/Modular Home Unit No. 1 National Laboratory has an active system that incorporates 340 sq ft of flat black, single glazed, flat plate air heating collectors mounted at a 60 tilt on the south wall. The thermal storage is in 1536 pint jars of water. Data acquisition was accomplished with a Hewlett-Packard (HP) 3050

system controlled with a HP 9825 desk top calculator. The solar energy system has provided about 70% of the heating requirements of the house each season. Although the active solar energy system provides a major fraction of the space and domestic hot water requirements, the yearly total energy supplied is low. This is primarily because the house load is lower than expected because of passive gains and internal heat generation. Low performance is also the result of a low storage mass and several possible uncontrolled air leaks. DOE

N83-28724# California Univ., Berkeley. Lawrence Berkeley Lab.

MONITORED SUPERINSULATION AND SOLAR HOUSES IN NORTH AMERICA: A COMPILATION AND ECONOMIC ANALYSIS

J. C. RIBOT, J. G. INGERSOLL, and A. H. ROSENFELD Jun. 1982 7 p refs Presented at 7th Natl. Passive Solar Conf., Knoxville, Tenn., 29 Aug. 1982 (Contract DE-AC03-76SF-00098) (DE82-018782; LBL-14576; CONF-820819-12) Avail: NTIS HC A02/MF A01

In ongoing compilation, BECA-A (Building Energy-Use Compilation and Analysis, Part A, New Homes) 97 submetered, energy-efficient homes in North America and Europe have been analyzed. Only 21 have acceptable data on added first cost of conservation measures. Of these, the lowest cost of conserved energy $\text{d}\$/\text{dE}$ is for the superinsulated category, where $\text{d}\$/\text{dE}$ is about $\$7/\text{MBtu}$. Only 22 homes have submetering adequate to permit correcting space heating loads for variations in occupant behavior (thermostat preference and heat gains from appliances). For these 22, the standardized fuel intensity is only 67 kJ/sq m-DD, compared to US 1979 building practice of 140, or US stock of 260 DOE

N83-28729# Council of American Building Officials, Falls Church, Va.

HOME STUDY GUIDE FOR USE WITH THE MANUAL FOR SOLAR SPECIALISTS

Jul. 1982 148 p (Contract DE-AC01-78CS-34281) (DE82-019400; DOE/CS-34281/2) Avail: NTIS HC A07/MF A01

The manual for solar specialists is presented. Each lesson in each unit of the study guide gives goals and objectives references, and exercises. For each unit a test over the material is given. Fundamentals of solar radiation, passive and active solar systems, hybrid systems, and code provisions are covered. Terms important to each unit are listed. DOE

N83-28735# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.

POSSIBLE APPLICATION OF SOLAR-THERMAL ENERGY IN THE CHEMICAL INDUSTRY

L. R. MARTIN Jun. 1982 29 p refs (Contract DE-AI03-81SF-11578, F04701-81-C-0082) (DE82-019218; DOE/SF-11578/T1; ATR-82(2835)-ND) Avail: NTIS HC A03/MF A01

Eight chemicals are identified that require substantial amounts of nonrecoverable energy for their production. The chemicals are: ethylene, vinyl chloride, styrene, propylene, butadiene, isoprene, hydrogen, and phosphorus. These chemicals are used to produce a wealth of products such as plastics, rubbers and fertilizers. In most cases, these energy intensive materials are at the top of a pyramid of subsequent, exothermic reactions and products that do not require additional thermal energy except for separation processes. Their production at present is centralized and done on a large scale, and most of the organics are produced in refineries where hydrocarbon energy is abundant. This association with refineries means at present that direct substitution of solar energy for hydrocarbon fired heaters may not be convenient, even though scientifically feasible. Other solar energy applications are production of caustic soda from thermodynamic cycles, ethylene from ethanol, and butadiene from ethanol. DOE

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N83-28736# Brookhaven National Lab., Upton, N Y Dept of Chemistry.

SOLAR ENERGY STORAGE BASED ON METAL COMPLEXES

N. SUTIN 1982 14 p refs Presented at the US-Japan Seminar on Solar Energy Conversion, Honolulu, Haw., 22 Mar. 1982

(Contract DE-AC02-76CH-00016)

(DE82-015246; BNL-31232; CONF-820370-1) Avail NTIS HC A02/MF A01

Some systems based on the use of metal complexes to mediate the homogeneous photodecomposition of water into hydrogen and oxygen are described. Tris(bipyridine)ruthenium(II) as the photosensitizer is emphasized. The excited states of a number of other mononuclear, binuclear, and polynuclear complexes are summarized. It is noted that the excited-state lifetimes range from milliseconds to nanoseconds, that some of the excited states are good reductants while others are good oxidants and that, except for the M^{+}/M (1), M^{2+}/M^{+} (2), $Fe(bpy)_3^{2+}/Fe(bpy)_3^{3+}$ couple, the ground and excited state couples generally undergo very rapid electron exchange reactions. DOE

N83-28737# Lincoln Lab., Mass Inst. of Tech., Lexington.

PHOTOVOLTAIC-SYSTEM EVALUATION AT THE NORTHEAST RESIDENTIAL EXPERIMENT STATION Final Report, Nov. 1980 - May 1982

M. C. RUSSELL Jan. 1983 163 p refs

(Contract DE-AC02-76ET-20279)

(DE83-008259; DOE/ET-20279/219) Avail: NTIS HC A08/MF A01

Five residential photovoltaic systems were tested and the systems' performance and cost was evaluated. The five systems each consist of an unoccupied structure employing a roof mounted photovoltaic array and a utility connected power inverter capable of sending excess PV generated energy to the local utility system. The photovoltaic systems are designed to meet at least 50% of the total annual electrical demand of residences in the cold climate regions of the country. The following specific issues were investigated: photovoltaic array and inverter system power rating and performance characterization, system energy production, reliability and system cost/worth. Summary load data from five houses in the vicinity of the Northeast Residential Experiment Station, and meteorological data from the station's weather station are also presented. DOE

N83-28743# International Inst. for Applied Systems Analysis, Laxenburg (Austria). Energy Systems Group.

THE FUTURE UTILIZATION OF SOLAR ENERGY IN A WESTERN EUROPEAN CONTEXT, PART 1 Final Report, Jun. 1981

N. NAKICENOVIC and S. MESSNER Bonn Bundesministerium fuer Forschung und Technologie Feb. 1983 291 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 2 Vol.

(BMFT-FB-T-83-001-PT-1; ISSN-0340-7608) Avail: NTIS HC A13/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 45,50

Three scenarios specifying possible but not necessarily likely transitions to a reliable energy system for Western Europe were considered. The scenarios are based on dynamic balances of energy demand and supply using detailed models to achieve consistency. Two scenarios consider exclusively solar energy, one based on centralized solar technologies (hard scenario) and the other on decentralized, user-oriented technologies (soft scenario). The third scenario, based on nuclear technologies, incorporates an intermediate degree of centralization in the energy system and serves as a comparison to the two exclusively solar scenarios. All three scenarios lead to reliable energy futures before the year 2100, which is the time horizon of the study. While all three scenarios eliminate Western Europe's dependence on domestic and foreign fossil energy sources, the hard solar scenario requires substantial imports of solar produced hydrogen. Author (ESA)

N83-28744# International Inst for Applied Systems Analysis, Laxenburg (Austria) Energy Systems Group

THE FUTURE UTILIZATION OF SOLAR ENERGY IN A WESTERN EUROPEAN CONTEXT, PART 2 Final Report, Jun. 1981

N. NAKICENOVIC and S. MESSNER Bonn Bundesministerium fuer Forschung und Technologie Feb. 1983 27 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 2 Vol.

(BMFT-FB-T-83-002-PT-2; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5,50

Three scenarios specifying possible but not necessarily likely transitions to a reliable energy system for Western Europe were considered. The scenarios are based on dynamic balances of energy demand and supply using detailed models to achieve consistency. Two scenarios consider exclusively solar energy, one based on centralized solar technologies (hard scenario) and the other on decentralized, user-oriented technologies (soft scenario). The third scenario, based on nuclear technologies, incorporates an intermediate degree of centralization in the energy system and serves as a comparison to the two exclusively solar scenarios. All three scenarios lead to reliable energy futures before the year 2100. While all three scenarios eliminate Western Europe's dependence on domestic and foreign fossil energy sources, the hard solar scenario requires substantial imports of solar produced hydrogen. Author (ESA)

N83-28746# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Neue Technologien-Forschung.

POSSIBILITIES OF INCREASED ENERGETIC USE OF PHOTOCHEMICAL, PHOTOELECTROCHEMICAL AND BIOLOGICAL METHODS OF SOLAR ENERGY CONVERSION Final Report, Feb. 1982

E. HAMER, H. MOEHWALD, B. OBKIRCHER, W. SCHAEFER, and B. SCHROEDER Bonn Bundesministerium fuer Forschung und Technologie Mar. 1983 333 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-83-036; ISSN-0340-7608) Avail: NTIS HC A15/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 50

Methods of photochemical, photoelectrochemical and biological solar energy conversion were elaborated for economical use in a far future. Present status and possibilities of development; physical and technical limitations, and cost of use in possible applications are discussed. The most promising method is the photoelectrochemical generation of electricity. Cases in which the production of biomass and the production of methanol by solar energy are feasible are outlined. The other methods, including those producing hydrogen by means of sunlight, cannot be used economically in regions of temperate climate. Author (ESA)

N83-28748# Economic Research Service, Washington, D. C. National Economics Div.

PHOTOVOLTAICS: TECHNOLOGICAL PROGRESS AND ITS FUTURE IN AGRICULTURE

W. G. HEID, JR. Nov. 1982 129 p refs

(PB83-147728; AGES-820707) Avail: NTIS HC A07/MF A01 CSCL 10B

Advances in photovoltaic technology are rapidly bringing it into the range of competitiveness with conventional and other alternative energy source. Photovoltaic systems can be used for nearly all of agriculture's stationary power needs, including energy to operate appliances and to heat farm homes. It is an appropriate technology for small as well as larger sized farms. As researchers and farmers weigh future alternative energy choices, photovoltaic systems should be included in their economic comparisons. Author (GRA)

N83-29125# California Univ., Livermore. Lawrence Livermore Lab Dept. of Electronics Engineering.

LGF DATA-ACQUISITION SYSTEM

J BAKER Jul 1982 16 p

(Contract W-7405-ENG-48)

(DE82-019228; UCID-19431) Avail: NTIS HC A02/MF A01

A flexible and powerful data acquisition system was developed at Lawrence Livermore National Laboratory (LLNL) for use in liquefied natural gas (LNG) dispersion experiments. The system consists of 51 solar-powered, portable data acquisition units, a van-based minicomputer control and data-recording system, 65 towers, and nearly 300 sensors. The complement of sensors includes methane gas sensors, thermocouples, anemometers, humidity sensors, and heat flux sensors. The system utilizes UHF radio telemetry for command and data transmission and is designed to acquire data from sensors distributed over a large area with a diameter of up to 10 miles. Twenty of the portable data acquisition units acquire wind field data from two-axis anemometers. The remaining 31 data acquisition units are used to acquire data from a wide variety of sensors. Data acquisition rates and channel assignments are programmable. DOE

N83-29477# Allied Chemical Corp., Morristown, N.J.

SOLAR ASSISTED GAS-FIRED ABSORPTION HEAT PUMP Final Report, Mar. 1981 - Aug. 1982

K. P. MURPHY, J. C. BURKE, and B. A. PHILLIPS Aug. 1982 137 p refs

(PB83-167502; GRI-80/0172) Avail: NTIS HC A07/MF A01 CSCL 13B

An evaluation of the technical and economic feasibility of coupling an absorption heat pump and an active solar system for residential applications is discussed. The absorption heat pump is based on a new absorption working pair developed by Allied. Three basic modes of coupling were considered, a series arrangement, a parallel arrangement, and a solar drive arrangement. Little overall difference in performance was found for these three modes but the solar drive was chosen for detailed study. A preliminary design of a dual mode absorption generator was developed capable of using simultaneously heat from gas and solar. The performance of such a system was examined in three cities. GRA

N83-29479# Booz-Allen and Hamilton, Inc., Bethesda, Md.

ASSESSMENT OF RESIDENTIAL PASSIVE SOLAR/GAS-FIRED ENERGY SYSTEMS Final Report, Nov. 1981 - Aug. 1982

D. L. HARTMAN and A. S. HIRSHBERG Dec. 1982 138 p

(PB83-167239; GRI-81/0090) Avail: NTIS HC A07/MF A01 CSCL 13B

The study was made to provide a comprehensive analysis of the issues involved in integrating passive solar with gas-fired back-up energy systems including: characterize major passive solar technologies; analyze technical and economic requirements of back-up heating and cooling systems; evaluate potential improvements for gas-fired heating equipment that could enhance its fit with passive solar heating; investigate the feasibility of passive solar cooling coupled with gas dehumidification equipment; and identify R&D opportunities for GRI which offer benefits to the gas ratepayer and to the gas industry. Passive solar heating, because of its potential to significantly reduce home heating loads and of the ease with which electric backup systems can be installed could result in a decrease in gas market share, as a primary heating fuel in new housing. Author (GRA)

N83-29641# Argonne National Lab., Ill

THERMALLY STRATIFIED TANKS

R. L. COLE and F. O. BELLINGER 1982 18 p refs Presented at the ASHRAE Natl. Meeting, Toronto, 27 Jun. 1982

(Contract W-7405-ENG-38)

(DE83-009089; CONF-820664-12) Avail: NTIS HC A02/MF A01

How tanks fail to stratify is discussed, as well as a new solar collection strategy that allows stratification to be maintained. A theory that models thermally stratified tanks reasonably well is briefly summarized. Tests of tanks fitted with various internal baffle

and diffuser configurations are described. Conclusions are: the new collection strategy is essential for maintaining stratification; and most tanks can remain stratified in diurnal cycling. Dip tubes and vertical baffles degrade stratification. Tank walls should have low heat capacity compared to that of water. Tanks with a height to diameter ratio of about four provide the best stratification without excessive thermal losses. Simple inlet and outlet diffusers provide the test thermal stratification. DOE

N83-29815# El Paso Electric Co., Tex.

NEWMAN UNIT 1 ADVANCED SOLAR REPOWERING ADVANCED CONCEPTUAL DESIGN Final Report

Apr. 1982 361 p 2 Vol.

(Contract DE-AC03-81SF-11566)

(DE82-014899; DOE/SF-11566/2-VOL-1) Avail: NTIS HC A16/MF A01

The Newman Unit 1 solar repowering design is a water/steam central receiver concept supplying superheated steam. System level functional requirements, design, operation, performance, cost, safety, environmental, institutional, and regulatory considerations are described. Subsystems described include the collector, receiver, fossil energy, electrical power generating, and master control subsystems, site and site facilities. The conceptual design, cost, and performance of each subsystem is discussed at length. A detailed economic analysis of the repowered unit is made to realistically assess the economics of the first repowered unit using present cost data for a limited production level for solar hardware. Finally, a development plan is given, including the design, procurement, construction, checkout, startup, performance validation, and commercial operation. DOE

N83-29816# El Paso Electric Co., Tex.

NEWMAN UNIT 1 ADVANCED SOLAR REPOWERING Final Report

Apr. 1982 155 p refs 2 Vol.

(Contract DE-AC03-81SF-11566)

(DE82-014898; DOE/SF-11566/2-VOL-2) Avail: NTIS HC A08/MF A01

The five appendices give the selection process and system specification of the Newman Unit 1 solar repowering system. The conceptual design drawings and diagrams; input data for the simulation program; and a review of the most important characteristics of the existing plant are included. DOE

N83-29829# AiResearch Mfg Co., Torrance, Calif.

DEVELOPMENT OF A SOLAR-DESICCANT DEHUMIDIFIER, PHASE 2 Final Summary Report, 1 Sep. 1980 - 31 Mar. 1982

J. ROUSSEAU 1 Nov. 1982 51 p refs

(Contract DE-AC03-77CS-31591; EG-77-C-03-1591)

(DE83-005407; DOE/CS-31591/T8) Avail: NTIS HC A04/MF A01

The solar desiccant air conditioner (SODAC), its operation, characteristics of the major components, performance at design conditions, and the control schemes to optimum operation in various climates are described for both recirculated and ventilated configurations, with greater emphasis on the recirculated configuration. The development testing and the determination of the SODAC performance in both configurations over the entire range of interfacing parameters are reported. DOE

N83-29831# Midwest Research Inst., Golden, Colo. Building Systems Research Branch.

MEASURED PERFORMANCE RESULTS: LOW-COST SOLAR WATER HEATING SYSTEMS IN THE SAN LUIS VALLEY

J. SWISHER Jan. 1983 41 p refs

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE83-006488; SERI/TR-254-1727) Avail: NTIS HC A03/MF A01

The measured performance of seven low-cost solar water heating systems in the San Luis Valley of southern Colorado is summarized. During the summer and fall of 1981, SERI monitored a variety of low-cost solar water heating system designs and components. Five systems had site-built collectors, and four

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included low-cost tank-in-jacket heat exchanger/storage tank components. Two were air-to-water systems. The five liquid-based systems included a drain-down design, a propylene glycol-charged thermosiphon system, and three pumped-glycol systems. The pumped-liquid systems performed the best, with system efficiencies greater than 20% and solar fractions between 40% and 70%. The air-to-water systems did not perform as well because of leakage in the collectors and heat exchangers. The thermosiphon system performed at lower efficiency because the collector flows were low. DOE

N83-29832# Texas Technological Univ., Lubbock.
CROSBYTON SOLAR POWER PROJECT. VOLUME 8:
PRELIMINARY DESIGN OF 55-MWE SOLAR-FOSSIL HYBRID
ELECTRIC POWER PLANT AT CROSBYTON, TEXAS

4 Feb 1982 644 p

(Contract DE-AC04-76ET-20255)

(DE83-005285; DOE/ET-20255/T1) Avail: NTIS HC A99/MF A01

This report presents the preliminary design and the construction cost for a 5 MWe Solar Hybrid Electric Energy Plant (SHEEP) to be built at Crosbyton, Texas. The plant has been designed to serve as a small size, commercially operable power plant which fully demonstrates the function, performance, and cost of this solar technology and integrated steam management concept. Good lifetime performance at minimum cost were the critical design objectives. The major solar components of this plant are ten 203 foot diameter stationary tilted quartersphere solar bowls. Each with a slender 58 foot solar receiver which tracks the solar focus produced by the bowl. At peak insolation the ten bowls will produce sufficient steam to generate 5 MWe. This plant has only a few minutes of thermal storage capability. The plant has a fossil boiler (oil or gas fired) which is integrated into the solar-turbine steam loop to provide supplemental steam for electric generation at night or during periods of low insolation. DOE

N83-29834# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION
EXPERIMENT OPERATIONAL PERFORMANCE REPORT FOR
G. N. WILCOX MEMORIAL HOSPITAL, KAUAI, HAWAII FOR
OCTOBER 1982, VOLUME 6

Jan 1983 28 p

(Contract DE-AC04-76DP-00789)

(DE83-006415; SAND-81-7080/6) Avail: NTIS HC A03/MF A01

Presented are the data accumulated during October 1982 at the intermediate project at G N Wilcox Memorial Hospital, Kauai, Hawaii. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-29838# Sandia Labs, Albuquerque, N. Mex Applied Mechanics Div.

INFLUENCE OF ADHESIVE SHEAR DEFORMATION ON
LAMINATE STRUCTURAL BEHAVIOR WITH APPLICATION TO
PARABOLIC TROUGH SOLAR COLLECTORS

D. B. CLAUSS and R. C. REUTER, JR. Feb. 1983 44 p refs

(Contract DE-AC04-76DP-00789)

(DE83-010293; SAND-82-1825) Avail: NTIS HC A03/MF A01

A simplified theory for the bending behavior of a thin flat bilamina panel was developed which includes the effects of shear deformation in the central adhesive layer. Static equilibrium equations for elastic thermomechanical cylindrical bending of a thin plate are used. A solution form is proposed which greatly facilitates application of this theory to structural panels with numerous discrete property changes in the variable direction. The influence of adhesive shear stiffness parameters upon overall laminate behavior is characterized through numerical examples typifying various thermal and mechanical loading conditions. DOE

N83-29840# Zeopower Co., Natick, Mass

DEVELOPMENT OF LOW-COST INTEGRATED ZEOLITE
COLLECTOR, SUPPLEMENT Final Report, 25 Sep. 1980 - 24
Sep. 1981

D. I. TCHERNEV Feb 1983 125 p

(Contract DE-AC03-78CS-32117)

(DE83-008484; DOE/CS-32117/2; SAN-2117-2) Avail: NTIS HC A06/MF A01

A low cost zeolite collector was built and the experimental data from the collectors at the different test sites in the USA were analyzed. The suitability of different methods of corrosion protection of low cost materials was studied. It is found that the phenolic coating which is suitable is more expensive than the copper it replaces. Fiber glass epoxy is suitable as a container material for the zeolite, however, there are some problems with the vacuum seal due to the mismatch of thermal expansion coefficients. Low cost collectors were constructed and tested. Cost reduction of a factor of six is possible in mass production. DOE

N83-29841# Purdue Univ., Lafayette, Ind. Lab. for Heat Transfer.

FORCED- AND NATURAL-CONVECTION STUDIES ON SOLAR
COLLECTORS FOR HEATING AND COOLING APPLICATIONS
Final Report

J. T. PEARSON Mar 1983 126 p refs

(Contract DE-AC04-78CS-35366; EM-78-C-04-5366)

(DE83-009863, ALO-5366-4) Avail: NTIS HC A07/MF A01

Convection in air heating solar collectors for heating and cooling applications was studied. It was determined that improvement in the overall conductance between the absorber and the flowing air was an area that needed much improvement. Studies were performed to obtain several absorber convector configurations which have superior heat transfer performance, modest drop penalties, and a high potential for economical manufacturing. Four surfaces which may be fabricated from aluminum or steel are recommended. Three utilize corrugated sheets bonded to the backplate and/or the back side of the absorber. These three surfaces are recommended for applications where airflow behind the absorber is appropriate. For those applications where airflow above the absorber is appropriate, a louvered surface which can be fabricated from metal or plastic is recommended. DOE

N83-29842# Sandia Labs, Albuquerque, N. Mex Solar Systems Applications Div.

SOLAR TOTAL ENERGY PROJECT SUMMARY DESCRIPTION

R. W. HUNKE and J. A. LEONARD Mar. 1983 20 p

(Contract DE-AC04-76DP-00789)

(DE83-010232, SAND-82-2249) Avail: NTIS HC A02/MF A01

The Solar Total Energy Project (STEP) at Shenandoah, GA is described. A summary description of the energy system, its location, and the project site are presented. The system is further described including design criteria and requirements, performance criteria, and operating requirements. The major subsystems of the STEP - the solar collection subsystem (SCS), the power conversion subsystem, the thermal utilization subsystem, the control and instrumentation subsystem, and the electrical subsystem are described, including their major components. Specific features of the control and instrumentation provisions for the system and subsystem operational modes are also described and the costs of construction presented. DOE

N83-29843# Sandia Labs, Albuquerque, N. Mex. Systems Evaluation Div.

THE 10-MWE CENTRAL-RECEIVER SOLAR-THERMAL
PILOT-PLANT TEST OPERATION PLAN

J. S. ANDERSON and J. W. SMITH Mar. 1983 197 p

(Contract DE-AC04-76DP-00789)

(DE83-009737; SAND-82-8025) Avail: NTIS HC A09/MF A01

Stable, controlled operation in each of the steady state operational modes and data for performance evaluation were demonstrated. The operational modes are tested, and transitions, emergency shutdowns, preliminary power production, and certain other plant characteristics are demonstrated. The tests define the

conditions which will establish plant operation at a near optimum combination of annual energy output and O and M cost. Test specifications, containing specific test requirements, are provided for those tests that will be conducted during start up and the experimental test and evaluation phase of the pilot plant DOE

N83-29844# Boeing Computer Services, Inc., Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION
 EXPERIMENT OPERATIONAL PERFORMANCE REPORT.
 VOLUME 6: CDC LIGHT MANUFACTURING BLDG., SAN
 BERNARDINO, CA FOR AUGUST 1982**

Mar. 1983 28 p Prepared for Sandia National Labs.

(Contract DE-AC04-76DP-00789)

(DE83-010390; SAND-81-7089/6) Avail. NTIS HC A03/MF A01

Presented are the data accumulated during August at the intermediate photovoltaic project at the CDC Light Manufacturing Bldg., San Bernardino, California. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-29849# Boeing Computer Services, Inc., Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION
 EXPERIMENT OPERATIONAL PERFORMANCE REPORT.
 LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW
 MEXICO FOR NOVEMBER 1982, VOLUME 17**

Jan. 1983 27 p

(Contract DE-AC04-76DP-00789)

(DE83-006721; SAND-81-7085/17) Avail. NTIS HC A03/MF A01

The data accumulated during November 1982 at the intermediate photovoltaic project at Lovington Square Shopping Center, Lovington, New Mexico, are presented. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided. DOE

N83-29850# Indiana State Hospital, Evansville Dept. of
 Engineering Technology
**FEASIBILITY OF NIGHT-SKY RADIATION WITH HEAT PUMPS
 B.S. Thesis**

T. G. MCKINNEY 1982 31 p refs

(Contract DE-FG02-81R5-10298)

(DE83-006812; DOE/R5-10298/2) Avail. NTIS HC A03/MF A01

This report presents the procedure involved in the determination of the feasibility of high-sky radiation as the means of rejecting heat through solar collectors for a sample residential house in the Evansville area. It presents conclusions on different types of coatings that are used in solar collectors. It also designs the system, and its backup, in schematic form. For the purpose of cost analysis it discusses the difference of a cooling tower and night-sky radiation. DOE

N83-29854# Vitro Labs., Silver Spring, Md.
**SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION.
 SCOTTSDALE COURTHOUSE, SCOTTSDALE, ARIZONA,
 MARCH, APRIL, JULY, AUGUST, AND OCTOBER 1981
 THROUGH FEBRUARY 1982**

P. E. WETZEL 1982 76 p refs

(Contract DE-AC01-79CS-30027)

(DE82-019030; SOLAR/2055-82/14) Avail. NTIS HC A05/MF A01

The site is the County Courts Building in Scottsdale, Arizona. Its active solar energy system is designed to supply 100% of the heating and 60% of the cooling load. The system consists of 2723 square feet of concentrating collectors, 5000 gallons of hot water storage, 25.5-ton absorption chiller, and backup electric resistance heating and a 25-ton electric reciprocating vapor-compressor chiller. The system performed far below design expectations due to the extremely poor performance of the collector array. Performance data given include the solar fraction, solar savings ratio, conventional fuel savings, and coefficient of

performance. Monthly performance data are tabulated for the solar system and for each subsystem. Also given are monthly solar operating energy, energy savings, and weather conditions for each month. Typical system operation data are graphed and a typical operating sequence is given. Among the appendices are a brief system description, the performance evaluation techniques, typical monthly data, long-term weather data, and a brief discussion of sensor technology. DOE

N83-29855# Vitro Labs., Silver Spring, Md.
**SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION.
 CROWN REALTY 1, LAKEWOOD, COLORADO, DECEMBER
 1981 THROUGH MARCH 1982**

K. M. WELCH 1982 77 p refs

(Contract DE-AC01-79CS-30027)

(DE82-019029, SOLAR/2089-82/14) Avail. NTIS HC A05/MF A01

The Crown Realty 1 site is a small office building in Colorado. Its active solar space heating system is equipped with 907 square feet of liquid flat-plate collectors, 2500-gallon water storage tank, and several solar-assisted heat pumps with electric resistance strip auxiliary heating. Solar system performance data given include the solar fraction, solar savings ratio, conventional fuel savings, system performance factor and coefficient of performance. Although the solar fraction was 29%, the solar savings ratio reflects a 9% penalty due to operating energy expense. Monthly system performance data are tabulated, as well as performance data for each subsystem - the collector, storage, and space heating subsystems. Monthly solar operating energy, energy savings, and weather conditions data are also tabulated. Typical system operation data are also graphed and discussed, as is solar energy utilization. Among the appendices are a system description, performance evaluation techniques, typical monthly data, long-term weather data, and a brief discussion of the sensor technology. DOE

03

HYDROGEN

Includes hydrogen production, storage, and distribution

A83-30000
HYDROGEN ENERGY CREEPS FORWARD

G. GRAFF High Technology (ISSN 0277-2981), vol. 3, May 1983, p. 67-72

There have been hopeful forecasts of a 21st century 'hydrogen economy' in which cheap hydrogen fuel would finally end mankind's dependence on petroleum fuels. The present investigation is concerned with developments related to the possible realization of such forecasts. One vital factor involves the feasibility to provide hydrogen at competitive prices for use as a fuel. Industrial hydrogen is too expensive for applications involving a competition with currently used common fuels. A number of investigations are being conducted in the U.S. and in other countries with the aim to develop an economical process by which hydrogen can be obtained from water. There exist already a great number of feasible different approaches for obtaining hydrogen on the basis of the decomposition of the water molecule. However, problems still to be solved are related to the development of any of these approaches to the point of economic viability. Another crucial factor concerns the storage of hydrogen. Automakers are testing hydrogen-powered cars in which hydrogen is stored in liquid form or with the aid of metal hydrides. G.R.

A83-31375

METAL-HYDRIDE ENERGY-TECHNOLOGICAL PROCESSING OF HYDROGEN [METALOGIDRIDNA ENERGETEKHNOLOGICHNA PEREROBK A VODNIU]

V. V. SOLOVEI (Akademiia Nauk Ukrain's'koi RSR, Institut Problem Mashinobuduvannia, Kharkov, Ukrainian SSR) Akademii Nauk Ukrain's'koi RSR, Dopovidi, Seria A Fiziko-Matematichni ta Tekhnichni Nauki (ISSN 0002-3531), March 1983, p. 77-80. In Ukrainian.

The external and internal irreversibility of the thermochemical hydrogen compression cycle is analyzed in relation to the efficiency of heat utilization in a metal-hydride energy system. The properties of the working fluid and the design of the metal-hydride elements are shown to have a considerable effect on the thermodynamic performance of a heat-utilizing installation for hydrogen processing. B.J.

A83-31504

HYDROGEN FUEL - UNIVERSAL ENERGY

A. G. PRINCE (Gould, Inc., Ocean Systems Div., Cleveland, OH) and J. A. BURG Meeting sponsored by the Institute of Environmental Sciences. IN: Energy and the Environment, Proceedings of the Twenty-seventh Annual Technical Meeting on Emerging Environmental Solutions for the Eighties, Los Angeles, CA, May 5-7, 1981. Volume 2 Mt. Prospect, IL, Institute of Environmental Sciences, 1981, p. 11-24. refs

The technology for the production, storage, transmission, and consumption of hydrogen as a fuel is surveyed, with the physical and chemical properties of hydrogen examined as they affect its use as a fuel. Sources of hydrogen production are described including synthesis from coal or natural gas, biomass conversion, thermochemical decomposition of water, and electrolysis of water, of these only electrolysis is considered economically and technologically feasible in the near future. Methods of production of the large quantities of electricity required for the electrolysis of sea water are explored: fossil fuels, hydroelectric plants, nuclear fission, solar energy, wind power, geothermal energy, tidal power, wave motion, electrochemical concentration cells, and finally ocean thermal energy conversion (OTEC). The wind power and OTEC are considered in detail as the most feasible approaches. Techniques for transmission (by railcar or pipeline), storage (as liquid in underwater or underground tanks, as granular metal hydride, or as cryogenic liquid), and consumption (in fuel cells in conventional power plants, for home usage, for industrial furnaces, and for cars and aircraft) are analyzed. The safety problems of hydrogen as a universal fuel are discussed, noting that they are no greater than those for conventional fuels T.K.

A83-33862

VISIBLE LIGHT INDUCED CLEAVAGE OF WATER INTO HYDROGEN AND OXYGEN IN COLLOIDAL AND MICROHETEROGENEOUS SYSTEMS

J. KIWI, K. KALYANASUNDARAM, and M. GRAETZEL (Lausanne, Ecole Polytechnique Federale, Lausanne, Switzerland) IN: Solar energy materials. Berlin, Springer-Verlag, 1982, p. 37-125. refs

This review departs from a discussion of some basic features of light-induced electron transfer reactions in solutions. Particular emphasis is placed on charge separation and kinetic control of the events by organized molecular assemblies such as micelles and vesicles. Subsequently, we describe some fundamental aspects of redox catalysis with colloidal dispersions of noble metals and their oxides. The application of these concepts to the problem of hydrogen and oxygen production from water by visible light is illustrated. Detailed analysis is made of methods to obtain highly active and selective catalysts, and the performance of bifunctional redox catalysts in cyclic water cleavage systems by visible light is described. Author

A83-34037

MECHANISM OF FLAME PROPAGATION IN HYDROGEN-AIR AND METHANE-AIR SYSTEMS

S. FUKUTANI and H. JINNO (Kyoto University, Kyoto, Japan) IN: Numerical methods in laminar flame propagation; Proceedings of the Workshop, Aachen, West Germany, October 12-14, 1981. Brunswick, Friedr Vieweg und Sohn, Verlagsgesellschaft mbH, 1982, p. 167-181. refs

H₂-air and CH₄-air flames are simulated numerically with a view to elucidating the factors that determine the propagation mode of laminar premixed flames. It is shown that when O does not participate in any reaction steps, the flame propagation is governed by the diffusion of H. On the other hand, when O is an indispensable oxidizer, the combustion reactions are initiated when the temperature rises to around 1200 K. The temperature increase in this case is achieved solely through thermal conduction, without any combustion reactions being activated V.L.

A83-34038

FLAMES NEAR RICH FLAMMABILITY LIMITS, WITH PARTICULAR REFERENCE TO THE HYDROGEN - AIR AND SIMILAR SYSTEMS

N. R. CARTER, M. A. CHERIAN, and G. DIXON-LEWIS (Leeds University, Leeds, England) IN: Numerical methods in laminar flame propagation, Proceedings of the Workshop, Aachen, West Germany, October 12-14, 1981. Brunswick, Friedr. Vieweg und Sohn, Verlagsgesellschaft mbH, 1982, p. 182-191. refs

The properties of adiabatic hydrogen-oxygen-nitrogen flames are computed near the rich flammability region in an attempt to gain a better understanding of the compositional limits of flammability. Attention is drawn to the fact that attempted solutions of the time-dependent equations for adiabatic, one-dimensional flames in hydrogen-oxygen-nitrogen mixtures begin to encounter stability problems and to show oscillations at compositions which correspond rather closely with the observed flammability limits. The oscillatory behavior is similar in nature to that shown by Sivachinsky (1974) to occur in unstable flames supported by single global reactions having a strong temperature dependence of the reaction, with Le greater than unity. V.L.

A83-34866

A SOLAR-HYDROGEN ECONOMY FOR U.S.A.

J. OM. BOCKRIS (Texas A & M University, College Station, TX) and T. N. VEZIROGLU (Miami, University, Coral Gables, FL) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 5, 1983, p. 323-340. refs

The benefits, safety, production, distribution, storage, and uses, as well as the economics of a solar and hydrogen based U.S. energy system are described. Tropical and subtropical locations for the generation plants would provide power from photovoltaics, heliostat arrays, OTEC plants, or genetically engineered algae to produce hydrogen by electrolysis, direct thermal conversion, thermochemical reactions, photolysis, or hybrid systems. Either pipelines for gas transport or supertankers for liquefied hydrogen would distribute the fuel, with storage in underground reservoirs, aquifers, and pressurized bladders at sea. The fuel would be distributed to factories, houses, gas stations, and airports. It can be used in combustion engines, gas turbines, and jet engines, and produces water vapor as an exhaust gas. The necessary research effort to define and initiate construction of technically and economically viable solar-hydrogen plants is projected to be 3 yr, while the technical definition of fusion power plants, the other nondepletable energy system, is expected to take 25 yr

M.S.K.

A83-34867

A STUDY OF THE HYDRIDING KINETICS OF MG-(10-20 W/O) LANI₅

M. Y. SONG and J. Y. LEE (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 5, 1983, p. 363-367. refs

Empirical results are compared with theoretical predictions to identify the rate-determining step of a hydriding process involving addition of 10-20 wt. pct. LaNi₅ to Mg. Attention was given to the chemisorption rate, the splitting of the hydrogen molecules, the diffusion of hydrogen atoms through the hydride phase, and the phase transformation at the interface. Rate-equations were defined for each rate-controlling step. Experimental data were obtained on hydriding reactions at a pressure of 30 bar at 345 C. Chemisorption of hydrogen on the Mg surface was the rate-controlling step in the initial phase, as was the diffusion of hydrogen atoms through the hydride at a later stage. M.S.K.

A83-34868

A KINETIC MODEL OF HYDROGEN ABSORPTION IN CEMG12

S. H. LIM and J. Y. LEE (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 5, 1983, p. 369-371. refs

The kinetic processes of the hydriding reaction of CeMg12 were examined theoretically and experimentally. Rate equations were formulated for each of four reaction steps, which comprised H₂ chemisorption on CeMg12, cracking of the hydrogen molecules, hydrogen diffusion in the hydride phase, and a phase transformation at the metal/hydride interface. It was assumed that the particles were spherical and of uniform diameter, each saturated with hydrogen before hydride formation, and each reaction step maintained a quasi-steady state in conditions of constant temperature and pressure. Experimental data were obtained and compared to the theoretical predictions in regards to the reacted fraction and the reaction rate. The chemisorption step was found to be rate-controlling in the initial phases, while no rate-controlling mechanism was identified at a later stage. M.S.K.

A83-34869

THE QUESTION OF THE HYDROGEN INFRASTRUCTURE FOR MOTOR VEHICLES

H. BUCHNER (Daimler-Benz AG, Stuttgart, West Germany) (Chemie-Technik, vol. 10, 1981, p. 289-292) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 5, 1983, p. 373-380. Translation. refs

Production, distribution, storage, and the economics of hydrogen for home and automotive fuels are considered. The Otto engine is capable of burning either hydrogen or gasoline if minor modifications are made. Metal hydrides have proven capable of safely storing H₂ for vehicle use, but are heavier than corresponding gas tanks, implying weight optimization of a road vehicle is more important when considering H₂ as a fuel. H₂/gasoline hybrid vehicles could have an equal range, with 20-30 pct decrease in gasoline consumption and a large decrease in air pollution. The production of electrolyzers for the home could be in the form of electrical resistance heaters for supplying both home heat and fuel that can be used in the car. Details of a possible scenario for West Germany involving conversion of 2,000,000 households to all electric, electrolyzer heated households are provided, indicating replacement of 2.5 pct of the total gasoline requirements of that country is possible. M.S.K.

A83-35301

HYDROGEN ENERGY IN CANADA - I PROCEEDINGS OF THE FIRST HYDROGEN ENERGY SYMPOSIUM, UNIVERSITY OF WESTERN ONTARIO, LONDON, CANADA, MAY 1, 1981

A. MARGARITIS, ED. (Western Ontario, University, London, Canada) and T. N. VEZIROGLU (Miami, University, Coral Gables, FL) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 4, 1983, 79 p.

The present conference concerning research and development efforts in Canada that are aimed at the more efficient production and use of hydrogen considers the state-of-the-art in the vehicular storage of liquid and gaseous hydrogen, the benefit to be derived by deuterium-uranium nuclear power reactors from a hydrogen-electric economy, the effect of glucose concentration and pH on hydrogen production by Rhodospseudomonas Sphaeroides VM 81, and the characteristics of commercially proven systems for the large-scale development of hydrogen from various feedstocks. Also considered are future policy implications of the hydrogen economy, and the use of hydrogen as a space heating fuel in buildings. O.C.

A83-35302

HYDROGEN AS A FUEL

J. S. WALLACE and C. A. WARD (Toronto, University, Toronto, Canada) (Hydrogen Energy Symposium, 1st, London, Ontario, Canada, May 1, 1981) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 4, 1983, p. 255-268. Research supported by the Ontario Ministry of Transportation and Communications and Natural Sciences and Engineering Research Council of Canada. refs

Electrolysis-produced hydrogen employing hydroelectric or nuclear generation of electricity is expected to be available in Canada, at prices that are competitive with other transportation energy forms, before the end of this century. Attention is presently given to the use of carbon-free, electrolytically produced hydrogen as a motor vehicle fuel and as a vehicular fuel cell fuel. An assessment of alternative onboard hydrogen storage systems, including metal hydride tanks, pressure vessels, permeable glass microspheres, and cryogenic tanks, indicates that hydrogen-fueled vehicles must be considerably more efficient than present gasoline-fueled internal combustion engines in order to compensate for the greater size and weight typical of the hydrogen storage systems. Fuel cells are considered as inherently more efficient systems than internal combustion engines for vehicular propulsion. O.C.

A83-35304

COST-EFFECTIVE METHODS FOR HYDROGEN PRODUCTION

R. G. MINET (Kinetics Technology International Corp., Pasadena, CA) and K. DESAI (Union Carbide Corp., Tarrytown, NY) (Hydrogen Energy Symposium, 1st, London, Ontario, Canada, May 1, 1981) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 4, 1983, p. 285-290.

A discussion is conducted concerning commercially proven systems for large scale production of hydrogen from various feedstocks, with attention to the alternative processing routes which determine the most favorable economic impact on the overall system. The processes considered are the partial oxidation of heavy feedstocks and the combination of steam reforming with wet system processing, pressure swing adsorption, and high and low temperature shift. Attention is also given to the influence of product purity, and comparisons are undertaken for process features, operating cost factors, and overall efficiency evaluations. O.C.

A83-35305

HYDROGEN FUEL FOR SPACE CONDITIONING OF BUILDINGS

U. BONNE (Honeywell Corporate Technology Center, Bloomington, MN) (Hydrogen Energy Symposium, 1st, London, Ontario, Canada, May 1, 1981) International Journal of Hydrogen Energy (ISSN 0360-3199), vol 8, no. 4, 1983, p. 295-299. refs

A comparative study is presented concerning the unique characteristics and relative advantages of hydrogen-air flames employed in boilers for building space heating. From the standpoint of safety, it is noted that the flammability limits of H₂, at 4-75 percent in air, are far wider than the 5-15 percent of CH₄. In addition to ignition characteristics, pipe sizing and storage tanks, stoichiometric fuel/air ratios, influence of fuel consumption on heating values, UV spectra, and the influence of fuel composition on fuel gas composition, are considered for a variety of hydrocarbon gas, heating oil, alcohols, and carbonaceous solid fuel alternatives to hydrogen. O.C

A83-37806

CALCULATION OF A PRESSURE RISE DURING THE BURNING OF A PLANE SUPERSONIC HYDROGEN JET IN A SUPERSONIC SLIPSTREAM [RASCHET POVYSHENIIA DAVLENIIA PRI GORENII PLOSKOI SVERKHZVUKOVOI STRUI VODORODA V SVERKHZVUKOVOM SPUTNOM POTOKE]

O. M. KOLESNIKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol 13, no. 6, 1982, p. 49-58. In Russian refs

A marching integration procedure is applied to parabolized Navier-Stokes equations in order to investigate the effect of heat release on pressure distribution during the burning of a plane supersonic hydrogen jet in a supersonic slipstream. It is shown that the procedure used here is sufficiently effective even if the Mach number of the jet drops to unity as a result of heat release and mixing. Examples are presented which show that ignition produces a 20-40-percent increase in pressure; this, in turn, intensifies combustion. Turbulent combustion has been calculated with allowance for the finite rates of chemical reactions in the quasi-laminar approximation. V.L.

A83-39560

INDUSTRIAL WATER ELECTROLYSIS - PRESENT AND FUTURE

R. L. LEROY (Electrolyser, Inc., Toronto, Canada) International Journal of Hydrogen Energy (ISSN 0360-3199), vol 8, no. 6, 1983, p. 401-417 refs

Present and developing technologies for the production of hydrogen from water are reviewed in the framework of the fundamental thermodynamic and kinetic constraints which govern the process. Attention is directed primarily to the direct electrolysis processes. Alkaline unipolar and bipolar, solid polymer electrolyte, and vapor-phase technologies are compared. It is concluded that alkaline electrolysis at temperatures below 150 C will be economically preferred over the next decade, while vapor-phase electrolysis is a development of significant but longer-term interest. Author

A83-39561

AN ASSESSMENT OF LARGE-SCALE SOLAR HYDROGEN PRODUCTION IN CANADA

E. BILGEN (Montreal, Universite, Montreal, Canada) and C. BILGEN (Exergy Research Corp., Montreal, Canada) International Journal of Hydrogen Energy (ISSN 0360-3199), vol 8, no. 6, 1983, p. 441-451. Research sponsored by the Central Mortgage and Housing Corp. refs

This study presents an assessment on the hydrogen production using a central receiver system coupled to either an electrolyzer plant or a thermochemical plant. Systems which are capable of producing 100,000 and 1,000,000 GJ per year thermal energy or about half of this as hydrogen were developed at four locations in Canada: Fort McMurray, London, Moncton and Victoria. For central receiver systems of 100,000 and 1,000,000 GJ per year thermal energy capacity, heliostat fields arranged to the north of the receiver and tower were developed. A code consisting of optical

and thermodynamic performance models was developed to simulate the system. For chemical plants, both electrolysis and thermochemical, codes were developed to simulate their thermodynamic performances. Cost models were developed for each subsystem based on the data published in the literature. Two scenarios were used for the heliostat prices: the first with a limited time and production capacity and the second with a quasi-optimized production capacity and production time. Estimates for the costs of hydrogen were then developed. The results indicated that levelized thermal energy costs ranged from \$17 to \$55 per GJ, electricity costs ranged from \$0.2 to \$0.5 per kWh and hydrogen costs from \$57 to \$157 per GJ. Author

A83-39562

STATUS OF HYDROGEN DEVELOPMENT FOR AIRCRAFT IN FIVE COUNTRIES - A CANADIAN PERSPECTIVE

J. MITCHELL (Transport Canada, Ottawa, Canada) International Journal of Hydrogen Energy (ISSN 0360-3199), vol. 8, no. 6, 1983, p. 453-458. refs

The results of studies funded by the Canadian government to identify fuel alternatives to oil derivatives and estimate the potential for H₂ as a fuel are presented. Hydrogen and electricity were concluded as the prime energy carriers in 50 years in Canada, and suggestions were made that the Canadian government initiate a long-term transition by funding programs to establish the infrastructure for hydrogen production, transportation, and use. Periodic reviews of the program were recommended at specified intervals. A conclusion was reached that electrolysis would be the lowest cost generation option by the 1990s. Widespread H₂ usage will depend on the progress in H₂-fueled road vehicles, on-board storage, and the distribution and refueling systems. Studies were also indicated in electrochemistry and safety. M.S.K.

N83-3476# California Univ., Livermore Lawrence Livermore Lab.

THERMOCHEMICAL HYDROGEN PRODUCTION STUDIES AT LLNL

O. H. KRIKORIAN 8 Jun 1982 7 p refs Presented at the Intern. Energy Agency Annex 1 Workshop on Thermochem. Hydrogen, San Diego, Calif., 22-24 Jun. 1982 (Contract W-7405-ENG-48) (DE82-016252, UCRL-87706; CONF-820646-1) Avail: NTIS HC A02/MF A01

Thermochemical hydrogen production based on magnetic fusion energy and solar central receivers as heat sources is studied. Some basic research is underway on the electrolysis of water from fused phosphate salts. DOE

N83-23482# Texas A&M Univ., College Station Center for Energy and Mineral Resources

BASIC RESEARCH OPPORTUNITIES FOR LASTING FUEL GAS SUPPLIES FROM INORGANIC RESOURCES

S. ADAMS, ed and S. R. BAEN 1 Oct. 1982 46 p Workshop held in College Station, Tex., 8 Jun - 14 Aug. 1981 (PB83-126268, GRI-82/0020) Avail: NTIS HC A03/MF A01 CSCL 21D

The production of fuel gases from inorganic resources using indefinitely sustainable energy sources were reviewed. Photobiological, biomimetic, photochemical, photoelectrochemical, radiolytic and thermochemical pathways leading to the generation of hydrogen from water and hydrogen sulfide, of carbon monoxide and methane from carbon dioxide, and of nitrogen based fuel gases from atmospheric nitrogen were assessed. GRA

N83-23766# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Inst fuer Technische Physik.

HYDROGEN TECHNOLOGY

W. PESCHKA In ESA Solar Energy 1982. Resources, Technol., Potential p 173-178 Nov. 1982 refs Avail: NTIS HC A12/MF A01

The elements of an energy economy based mainly on hydrogen are discussed. Large scale production of non-fossil hydrogen from

nuclear and solar energy; long-distance transport on an international scale including the associated possibilities of decoupling production and consumption; storage and distribution at home including the various types of coupling possible during conversion; and the use of hydrogen as an energy carrier in the various consumer sectors are discussed. Use of chemicals, iron and steel, in the upgrading of fossil energy carriers and in the production of synthetic liquid hydrocarbons is also discussed.

R.J.F.

N83-25058# General Electric Co., Wilmington, Mass. Direct Energy Conversion Programs.

STATUS OF THE DEVELOPMENT OF SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS FOR LARGE SCALE HYDROGEN GENERATION

J. H. RUSSELL /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev Meeting p 12-15 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

Solid polymer electrolyte water electrolysis for large scale hydrogen generation is reported. The program was aimed at performance improvement. Reductions in cell impedance were demonstrated which improve cell performance by over 100 mV. A prototype 500 SCFH system for field evaluation was developed.

Author

N83-25059# Life Systems, Inc., Cleveland, Ohio.

STATIC FEED WATER ELECTROLYSIS FOR LARGE SCALE HYDROGEN GENERATION

F. H. SCHUBERT and K. A. BURKE /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 22-28 Feb. 1982

Avail: NTIS HC A17/MF A01

The static feed water electrolysis concept was evaluated for application to large scale hydrogen generation. The effort addresses four areas: (1) definition of upper current density levels possible with the static feed concept, (2) investigation of operation with contaminated water sources (e.g., seawater), (3) scale up of cell area, and (4) definition of future scale up at the cell stack and system level. The static feed concept and results of each of the four program tasks are presented.

Author

N83-25061# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

RESEARCH OF ADVANCED ELECTROLYTIC HYDROGEN PRODUCTION

H. S. ISAACS, C. Y. YANG, and J. MCBREEN /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 35-39 Feb. 1982 refs

(Contract DE-AC02-76CH-00016)

Avail: NTIS HC A17/MF A01

Research on advanced electrolytic hydrogen production consisted of two areas. One was the development of an electrochemical method for investigation of the solid polymer electrolyte (SPE) electrocatalyst interface, the other was the development of stable photoanodes for photodecomposition of water by coating low barrier n type semiconductor with a thin film of n type TiO₂. By using various types of contact electrodes on SPE membranes, it was possible to use modern electrochemical techniques to investigate the SPE electrocatalyst interface under conditions simulating electrolyzer operation. Low barrier heterojunctions of thin films of n type TiO₂ on n type Fe₂O₃ were successfully demonstrated.

Author

N83-25066# General Electric Co., Wilmington, Mass.

RECOVERY OF HYDROGEN FROM HYDROGEN SULFIDE

G. N. KRISHNAN and D. L. HILDENBRAND /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 71-74 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

A process to recover hydrogen from hydrogen sulfide was developed and in which hydrogen sulfide reacts with liquid copper to form cuprous sulfide and hydrogen. In a subsequent step the

copper is recovered by oxidizing the sulfide. Preliminary bench scale experiments have shown that the reactions are rapid and approach equilibrium conversions with a gas residence time of a few hundred milliseconds.

Author

N83-27040# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

HYDROGEN DERIVED FROM AMMONIA: SMALL-SCALE COSTS

G. STRICKLAND Mar. 1982 13 p refs Presented at the 4th World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982 (Contract DE-AC02-76CH-00016)

(DE82-012720; BNL-31009; CONF-820605-17) Avail: NTIS HC A02/MF A01

A systems study was made to assess the economic prospects for using purchased industrial ammonia as a hydrogen distribution and storage medium for users requiring 0.93 to 9.34 million std cubic m/y of hydrogen (33 to 330 million std cubic ft /y). Projected costs to the end user were determined for: the product of dissociated ammonia (N₂ + H₂/NH₃), and the 99.999% pure H₂ obtained by separation of the nitrogen (H₂/N₂), electrolytic hydrogen (EH₂); purchased (merchant) liquid hydrogen (LH₂); OTEC (ocean thermal energy conversion) LH₂, as well as OTEC NH₃ and the H₂ products derived from it. Future costs are projected as dollars/GJ and as dollars/MBTU (1980 dollars in 1990) using two sets of forecast energy prices.

DOE

N83-27047# Los Alamos Scientific Lab., N. Mex.

THERMOCHEMICAL PROCESSES FOR SOLAR HYDROGEN PRODUCTION

M. G. BOWMAN 1982 7 p refs Presented at Ann Meeting of the Intern. Solar Energy, Houston, Tex., 31 May 1982

(Contract W-7405-ENG-36)

(DE82-019575; LA-UR-82-1895, CONF-8205112-1) Avail: NTIS HC A02/MF A01

The use of solar energy to produce hydrogen from water is an attractive concept that merits a continuing research and development effort. The base technology being developed for solar thermal power can be applied effectively in the production of hydrogen from water. Hydrogen production could be based on advanced water electrolysis and economic solar hydrogen become an eventual reality even if advanced processes do not prove to be feasible. Thermochemical cycles for decomposing water promise higher efficiencies if cycles can be developed that match the characteristics of solar heat sources. At present, cycles based on sulfuric acid are the most fully developed processes and they can be adapted to solar thermal systems and serve as standards of comparison for new cycles as they are discovered and developed. Advanced cycles based on solids decomposition reactions should interface advantageously with solar thermal systems and several cycles based on such reactions are under experimental evaluation.

DOE

N83-27414# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

ENGINEERING ANALYSIS OF POTENTIAL PHOTOSYNTHETIC BACTERIAL HYDROGEN-PRODUCTION SYSTEMS

A. HERLEVICH and M. KARPUK Jun 1982 15 p refs Presented at the SERI Biomass Program Principal Investigators Rev. Meeting, Washington, D.C., 23-25 Jun. 1982

(Contract EG-77-C-01-4042, DE-AC02-77CH-00178)

(DE82-019151; SERI/TP-235-1548R, CONF-820676-2) Avail: NTIS HC A02/MF A01

Photosynthetic bacteria (PSB) are capable of generating hydrogen from organics in effluents from food processing, pulp and paper, and chemical and pharmaceutical industries. Hydrogen evolution takes place under light in the absence of air. The rate of hydrogen production is expected to range between 300 to 600 scf of hydrogen per 1000 gallons of waste stream treated per hour. This hydrogen production system has been demonstrated at a bench-scale level and is ready for engineering development. A conceptual design for a PSB hydrogen production system is described. The system is expected to be sited adjacent to a waste

stream source which will be pretreated by fermentation and pH adjustment, inoculated with bacteria, and then passed into the reactor. The reactor effluent can either be discharged into a rapid infiltration system, an irrigation ditch, and/or recycled back into the reactor. Several potential reactor designs have been developed, analyzed, and costed. A large covered pond appears to be the most economical design approach. DOE

N83-27428# Oak Ridge National Lab., Tenn. Chemical Technology Div.

BIOSOLAR HYDROGEN AND OXYGEN PRODUCTION

E. GREENBAUM 1982 8 p refs Presented at the 4th World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982 (Contract W-7405-ENG-26)

(DE82-017491; CONF-820605-19) Avail: NTIS HC A02/MF A01

One approach to the production of renewable hydrogen is the utilization of the photochemical machinery of photosynthesis for the production of hydrogen and oxygen from water. This method of biological solar energy conversion includes two broad categories: (1) in vitro or non-living systems and (2) intact algal systems. Work in this area has focused on demonstrating the feasibility of the thermodynamically uphill reaction which splits water into its elemental constituents: H_2O yields $H_2 + 1/2O_2$. Recent progress has been encouraging in that all three known direct, biological, photosynthetic water-splitting systems have been shown capable of simultaneous photoproduction of hydrogen and oxygen with visible light. Recent results on the long-term stability of green algae for hydrogen and oxygen photoproduction are presented, as well as a review of previous results on the kinetics of hydrogen and oxygen production by photosynthesis. DOE

N83-28272# Brookhaven National Lab., Upton, N. Y.

ANODE DEPOLARIZERS IN ELECTROLYTIC HYDROGEN PRODUCTION

M. BELLER Jun 1982 16 p refs

(Contract DE-AC02-76CH-00016)

(DE82-018316; BNL-51562) Avail: NTIS HC A02/MF A01

Brookhaven National Laboratory manages an extensive program in the areas of hydrogen and energy storage potentials. As part of an ongoing portfolio analysis of projects, the prospects for applications for anode depolarizers are presented. The system requirements are outlined, and economic criteria are developed. It is concluded that moderate incentives exist for successful development. Research and Development priorities are formulated. DOE

N83-28274# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

STATUS OF ADVANCED ELECTROLYTIC HYDROGEN PRODUCTION IN THE UNITED STATES AND ABROAD

M. BONNER, T. BOTT, J. MCBREEN, A. MEZZINA, F. SALZANO, and C. Y. YANG 1982 13 p refs Presented at the World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982

(Contract DE-AC02-76CH-00016)

(DE82-009927; BNL-30987; CONF-820605-14) Avail: NTIS HC A02/MF A01

For the past five years the Department of Energy has sponsored a program aimed at the development of advanced technology for the electrolytic production of hydrogen. The original goal was to create a large-scale hydrogen production capability in the United States which would be based upon nonfossil energy resources and would be suitable for commercialization by industry as markets would be realized. Brookhaven National Laboratory (BNL) was assigned technical responsibility for a program which addresses hardware development at three industrial contractors as well as supporting fundamental research at BNL and several university laboratories. Recently, revised federal guidelines and budgetary reductions have resulted in a reversal of priorities which favor longer range research activities and which virtually eliminate the support of large-scale development engineering and test projects. Programs at BNL were redirected reflecting these revised guidelines and emphasizing longer-term research activities. DOE

N83-28591# General Atomic Co., San Diego, Calif.

THE SULFUR-IODINE THERMOCHEMICAL WATER-SPLITTING CYCLE

G. E. BESENBRUCH, J. H. NORMAN, L. C. BROWN, D. R. OKEEFE, M. ENDO, and C. L. ALLEN /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 31-35 Dec. 1982

Avail: NTIS HC A25/MF A01

Experimental work was carried out on process improvement concepts, resulting in an advanced process for treatment of the lower phase (H_2O -HI-I₂) and a liquid HI decomposition process utilizing homogeneous catalysis. Bench scale testing of design improvements was successfully carried out. A flowsheet for a solar thermal powered sulfur iodine water splitting process was developed and a cost estimate for hydrogen production completed. Author

N83-28594# Brookhaven National Lab., Upton, N. Y.

A TEST BED FOR ADVANCED HYDROGEN TECHNOLOGY PHOTOVOLTAIC ARRAY/ELECTROLYZER SYSTEM

G. STRICKLAND /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 48-52 Dec. 1982 refs

Avail: NTIS HC A25/MF A01

The development of an integrated test bed that will demonstrate a hydrogen production technology consisting of a photovoltaic array supplying electrical energy to an electrolyzer is discussed. The design of the experimental program leading to system evaluation is also described. M.G.

N83-28599# General Electric Co., Wilmington, Mass. Electrochemical Energy Conversion Program Office.

STATUS OF THE DEVELOPMENT OF SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS FOR LARGE SCALE HYDROGEN GENERATION

J. F. MCELROY /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 80-84 Dec. 1982

Avail: NTIS HC A25/MF A01

During GFY 82, progress continued at General Electric in the development of Solid Polymer Electrolyte Water Electrolysis for Large Scale Hydrogen Generation. The joint Department of Energy, Electric Utility and General Electric Company sponsored program was aimed at performance improvement. A Technoeconomic Study was completed which quantified the cost of hydrogen from SPE water electrolyzers. In parallel, an Electric Power Research Institute/Public Service Electric and Gas Program concentrated on developing a prototype 500 SCFH system for field evaluation. This system has undergone 2000 hours of confirmation testing and has been delivered to Public Service Electric and Gas for field evaluation. DOE

N83-28659# Los Alamos Scientific Lab., N. Mex.

TWO BISMUTH SULFATE-SULFURIC ACID HYBRID WATER-SPLITTING CYCLES. PROPOSED ANTIMONYL SULFATE CYCLE

W. M. JONES 1982 9 p refs Presented at World Hydrology Energy Conf., Pasadena, Calif., 13 Jun. 1982

(Contract W-7405-ENG-36)

(DE82-011976; LA-UR-82-583; CONF-820605-13) Avail: NTIS HC A02/MF A01

Two hybrid thermochemical cycles for the production of hydrogen which involve bismuth trisulfate and/or bismuth oxysulfates were investigated. Equilibrium sulfur trioxide pressure are given graphically for three solid gas equilibria involving $Bi_2(SO_4)_3$ alpha- and beta- $Bi_2O(SO_4)_2$, and $Bi_2O_2SO_4$. An improved method of carrying out the low temperature step for Cycle 1 is presented which may provide a remedy to a problem of sorption of sulfuric acid solution by the solids. An antimonyl sulfate - sulfuric acid hybrid cycle is outlined in which SO_2 and O_2 are evolved at different temperatures, simplifying the usual SO_3 - SO_2 - O_2 separation problem. DOE

N83-29336# SRI International Corp., Menlo Park, Calif
RECOVERY OF HYDROGEN FROM HYDROGEN SULFIDE: BENCH SCALE STUDIES OF THE REACTION OF HYDROGEN SULFIDE WITH LIQUID COPPER Final Report

G. N. KRISHNAN and D. L. HILDENBRAND May 1982 114 p refs

(Contract DE-AC02-76CH-00016)

(DE83-005947; BNL-51624) Avail: NTIS HC A06/MF A01

A bench scale study was conducted to examine the rate of reaction of hydrogen sulfide with liquid copper for the purpose of recovering hydrogen from hydrogen sulfide. The reaction rate at 1200 C was rapid and that the conversion of hydrogen sulfide to hydrogen approached the equilibrium level of 99.7%. The rate and the conversion remained constant until nearly all the copper was converted to cuprous sulfide. Using a model based on the Cu-S phase diagram, it was concluded that the gas phase mass transport was the rate controlling step during most of the reaction period. Preliminary technical and economic assessments were performed for a hydrogen recovery process based on liquid copper and cuprous sulfide intermediates. DOE

N83-29424# California Univ., Livermore. Lawrence Livermore Lab.

SYNFUEL FROM FUSION: USING THE TANDEM MIRROR REACTOR AND A THERMOCHEMICAL CYCLE TO PRODUCE HYDROGEN

R. W. WERNER, ed. 1 Nov. 1982 546 p refs Prepared in cooperation with California Univ., Davis and Washington Univ., Seattle and General Atomic Co., San Diego

(Contract W-7405-ENG-48; DE-AMOG-76RL-0222S;

DE-TA06-76ET-52047)

(DE83-005216; UCID-19609) Avail: NTIS HC A23/MF A01

Topics cover: (1) the tandem mirror reactor and its physics; (2) energy balance; (3) the lithium oxide canister blanket system; (4) high-temperature blanket; (5) energy transport system-reactor to process; (6) thermochemical hydrogen processes; (7) interfacing the GA cycle; (8) matching power and temperature demands; (9) preliminary cost estimates; (10) synfuels beyond hydrogen; and (11) thermodynamics of the H₂SO₄-H₂O system. DOE

N83-29845# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

SERI BIOMASS PROGRAM Annual Technical Report, 1982

P. W. BERGERON, R. E. CORDER, A. M. HILL, H. LINDSEY, and M. Z. LOWENSTEIN Feb. 1983 89 p refs

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE83-009763; SERI/TR-231-1918) Avail: NTIS HC A05/MF A01

The biomass with which this report is concerned includes aquatic plants, which can be converted into liquid fuels and chemicals; organic wastes (crop residues as well as animal and municipal wastes), from which biogas can be produced via anaerobic digestion; and organic or inorganic waste streams, from which hydrogen can be produced by photobiological processes. The Biomass Program Office supports research in three areas which, although distinct, all use living organisms to create the desired products. The Aquatic Species Program (ASP) supports research on organisms that are themselves processed into the final products, while the Anaerobic Digestion (ADP) and Photo/Biological Hydrogen Program (P/BHP) deals with organisms that transform waste streams into energy products. The P/BHP is also investigating systems using water as a feedstock and cell-free systems which do not utilize living organisms. This report summarizes the progress and research accomplishments of the SERI Biomass Program during FY 1982. DOE

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A83-30187#

FUTURE U.S. JET FUELS - A REFINER'S VIEWPOINT

K. H. STRAUSS (Texaco, Inc., Research Environment and Safety Dept., Beacon, NY) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 200-203. refs

Previously cited in issue 14, p. 2328, Accession no. A81-33876

A83-30196#

GASEOUS FUEL GENERATION BY MAGMA-THERMAL CONVERSION OF BIOMASS

T. M. GERLACH and H. C. HARDEE (Sandia National Laboratory, Albuquerque, NM) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 256-263. refs

(Contract DE-AC04-76DP-00789)

A wide range of upper crustal magma bodies provide suitable thermal energy sources for conversion of water-biomass mixtures to higher quality gaseous fuels. The compositions, concentrations, and energy contents of the generated fuel gases appear to be relatively insensitive to the type of magma body, but the rates at which fuels can be generated is strongly dependent on magma type. Fuel generation rates for basaltic magmas would be at least 2-3 times greater than those for andesitic magmas and 5-6 times those for rhyolitic magmas. CH₄ would be the main gas that can be generated in important quantities from magma-thermal energy under most circumstances. CO would never be important, and significant H₂ generation would be restricted to shallow basaltic magmas. Author

A83-30197#

VECTOR STATISTICS OF HOURLY WIND ADVECTION DATA FOR ENERGY TRANSPORT APPLICATIONS

S. ESKINAZI (Syracuse University, Syracuse, NY), H.-Z. GAO (University of Science and Technology of China, Hefei, People's Republic of China), and M. BORLE Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 264-271. refs

Use is made of the joint-probability density function in representing vector properties of wind advection in wind energy applications. It is shown that these functions, when plotted, reveal qualitative and quantitative wind transport characteristics dependent on surface site topography as well as diurnal heating and cooling cycles. In that sense, the vector 'wind print' developed at the site and for a given season has many permanent features and, therefore, is amenable to reliable engineering and scientific assessments of wind transported physical quantities. Author

A83-31612

COAL GASIFICATION USING SOLAR ENERGY

V. K. MATHUR, R. W. BREAUULT, and S. LAKSHMANAN (New Hampshire, University, Durham, NH) Solar Energy (ISSN 0038-092X), vol. 30, no. 5, 1983, p. 433-440. refs

(Contract DE-AC02-79ET-21067)

An economic evaluation of conventional and solar thermal coal gasification processes is presented, together with laboratory bench scale tests of a solar carbonization unit. The solar design consists of a heliostat field, a central tower receiver, a gasifier, and a recirculation loop. The synthetic gas is produced in the gasifier, with part of the gas upgraded to CH₄ and another redirected through the receiver with steam to form CO and H₂. Carbonaceous fuels are burned whenever sunlight is not available. Comparisons are made for costs of Lurgi, B₂-gas, Hygas, CO₂ Acceptor, and Peat Gas processes and hybrid units for each. Solar thermal systems are projected to become economical with 350 MWt output and production of 1,420,000 cu m of gas per day. The laboratory bench scale unit was tested with Montana rosebud coal to derive

a heat balance assessment and analyse the product gas. Successful heat transfer through a carrier gas was demonstrated, with most of the energy being stored in the product gas. M.S.K.

A83-32077

JET FUELS BASED ON WEST SIBERIAN OILS [REAKTIVNYE TOPLIVA IZ ZAPADNOSIBIRSKIKH NEFTEI]

A. F. GORENKOV, I. G. KLIUIKO, T. A. LIFANOVA, and A. I. KUPREEV. *Khimiia i Tekhnologiya Topliv i Masel* (ISSN 0023-1169), no. 4, 1983, p. 9-11. In Russian.

The physicochemical properties and the composition of jet fuel fractions with the final boiling points 250, 260, and 280 C which have been distilled from a mixture of West Siberian oils are presented. An analysis of these data indicates that West Siberian oils can be used for producing a jet fuel with an initial crystallization temperature of -50 C which satisfies the requirement of GOST 10227-62 standard for the T-1 fuel. The yield of this fuel is 16 percent higher than that of a fuel with an initial crystallization temperature of -60 C. The results of this study can be useful in optimizing the quality of jet fuels produced from West Siberian oils. V.L.

A83-32939

A SIMPLE MODEL FOR CARBON MONOXIDE IN LAMINAR AND TURBULENT HYDROCARBON DIFFUSION FLAMES

R. W. BILGER and S. H. STARNER (Sydney, University, Sydney, Australia). *Combustion and Flame* (ISSN 0010-2180), vol. 51, June 1983, p. 155-176. Research supported by the Australian Research Grants Committee and Garrett Turbine Engine Co. refs

A model has been developed for the composition in diffusion flames. It consists of a flame sheet for the pyrolysis or consumption of fuel on the rich side of stoichiometric. Near stoichiometric the molecular and radical species are assumed to be in partial equilibrium and the burnout of CO is controlled by the rate of recombination of the radicals in three-body reactions. The composition and reaction rates for the excess moles are expressible in terms of two variables, the mixture fraction and the excess moles. Calculations for these two variables have been carried out in laminar and turbulent jet diffusion flames and the predicted composition compared with experimental data. In broad terms the agreement is good and the prediction of CO on the lean and rich sides of both laminar and turbulent flames is particularly encouraging. Application of the model to the prediction of CO emissions in combustors is discussed. Author

A83-33481

TERRESTRIAL INERT GASES - ISOTOPE TRACER STUDIES AND CLUES TO PRIMORDIAL COMPONENTS IN THE MANTLE

J. E. LUPTON (California, University, Santa Barbara, CA). IN: *Annual review of earth and planetary sciences*, Volume 11. Palo Alto, CA, Annual Reviews, Inc., 1983, p. 371-414. Research supported by the U.S. Geological Survey and NSF. refs

The use of He-3/He-4 measurements for characterizing terrestrial materials and tracing natural-system processes is surveyed. Terrestrial He is classified according to its He-3/He-4 ratio, expressed as R/R-A where R-A is the He-3/He-4 ratio of atmospheric He, 1.4×10^{-6} to the -6th; radiogenic He typical of continental rocks has R/R-A of 0.01-0.1, while mantle He, typical of midoceanic ridge basalts (MORB) and other geothermal environments and attributed to gas entrapment during the earth's formation, has R/R-A of 5-30. Determinations of R/R-A for MORB and for samples from hot spots, from Tristan da Cunha, and from subduction zones are compared with Sr, Nd, Ar, Ne, and Xe data and shown to support a two-layer (depleted/fertile) model of the mantle, with mixing processes accounting for tectonic variations in R/R-A. The use of He-3 as a tracer for mapping ocean circulation patterns, studying ridge-crest tectonic and hydrothermal processes, and geothermal and hydrologic prospecting is described. T.K.

A83-34226

NUMERICAL METHODS IN THERMAL PROBLEMS. VOLUME 2 - PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE, VENICE, ITALY, JULY 7-10, 1981

R. W. LEWIS, ED., K. MORGAN, ED. (Swansea, University College, Swansea, Wales), and B. A. SCHREFLER (Padova, Università, Padova, Italy). Conference sponsored by the Consiglio Nazionale delle Ricerche and British Council. Swansea, Wales, Pineridge Press, 1981, 1327 p.

The present conference considers the fictitious domain method for the numerical solution of nonstationary thermal problems, discontinuous boundary elements for heat conduction, heat transmission through building construction elements, unsteady and nonlinear heat conduction in complex geometries, convection in liquid metal molds, heat transfer problems with high gradients and ablation, the study of charring ablation by means of finite elements, heat transfer numerical modeling for solidifying metals, and the numerical simulation of heat and mass transfer in porous materials. Also discussed are the geophase model for multiphase geothermal reservoirs, thermal cracking of a dam due to periodic temperature variations, thermal bending of layered composite plates and shells of bimodulus materials, numerical methods for the determination of stresses in a metal cutting tool, the large vibrations of elastic plates due to a thermal gradient, the stability of numerical time integration techniques for transient thermal problems, the application of the drift flux formulation to the modeling of diabatic two-phase flow, natural convection in a square cavity, and a general method for predicting the flows and temperatures in a network of interconnecting ducts. Industrial and scientific applications, free and forced convection, coupled conduction and convection, and turbulent heat transfer topics are also investigated. O.C.

A83-35789

A MODEL OF FREELY BURNING POOL FIRES

C. C. NDUBIZU, D. E. RAMAKER (George Washington University, Washington, DC), P. A. TATEM, and F. W. WILLIAMS (U.S. Navy, Naval Research Laboratory, Washington, DC). *Combustion Science and Technology* (ISSN 0010-2202), vol. 31, no. 5-6, 1983, p. 233-247. Navy-supported research. refs

This paper presents a zone model of liquid pool fires burning in an open environment. The model is a system of coupled non-linear equations which contains physical parameters for which reliable values are not currently available. With a judicious estimate of these parameters, the model was tested on various size fires burning three types of fuel. The predicted results are comparable with experimental results from three groups of earlier workers. Sensitivity analyses were run to determine the relative influence of each estimated parameter on the predicted results. These analyses show that efficiency of combustion in the fire is the most important estimated parameter in this model. Author

A83-35811#

FURTHER STUDIES ON THE PREDICTION OF SPRAY EVAPORATION RATES

J. S. CHIN (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China), A. H. LEFEBVRE (Purdue University, West Lafayette, IN), and W. G. FREEMAN. IN: *International Symposium on Air Breathing Engines*, 6th, Paris, France, June 6-10, 1983, Symposium Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 73-78. refs

Predictions based on the Chin, Durrett and Lefebvre (1983) equation for estimating the time required to evaporate any given fraction of the mass of a liquid fuel spray in stagnant air are compared with results obtained using a more accurate, but more tedious and time-consuming, iteration procedure. Attention is given to aviation gasoline, aviation kerosene, and the light diesel oil DF 2, over air pressure and air temperature ranges of 100-2000 kpa and 500-2000 K, respectively. The influence of fuel spray characteristics is examined by including mean drop size values of 30-120 microns in the calculations, while the Rosin-Rammler drop size distribution parameter is varied from 2.5 to 3.5. The comparison indicates that the equation proposed yields a simple and effective

means for deriving the evaporation times of fuel sprays in stagnant air. O.C.

**A83-35813#
THE EFFECTS OF FUEL PROPERTIES UPON POLLUTANTS
PRESENT IN GAS TURBINE AERO-ENGINES**

J. ODGERS and D. KRETSCHMER (UniversiteLaval, Quebec, Canada) IN: International Symposium on Air Breathing Engines, 6th, Paris, France, June 6-10, 1983, Symposium Papers. New York, American Institute of Aeronautics and Astronautics, 1983, p. 93-104. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

This paper discusses the probable impact of the alternative fuels upon the pollutants present in the exhaust of aircraft gas turbine. The major problem is identified as carbon (soot). Hydrocarbons, carbon monoxide and oxides of nitrogen are also considered. Possible solutions are suggested to minimize the various difficulties. Other phenomena (atomization, ignition and heat transfer) associated with alternative fuels are lightly touched upon. Author

**A83-36240#
FEASIBILITY OF A FULL-SCALE DEGRADER FOR
ANTIMISTING KEROSENE**

R. J. MANNHEIMER (Southwest Research Institute, San Antonio, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 19th, Seattle, WA, June 27-29, 1983. 8 p. Sponsorship: U.S. Department of Transportation. refs
(Contract DOT-FA79WA-4310)
(AIAA PAPER 83-1137)

An improved degrader for eliminating fuel filtering and atomization problems with aviation kerosene treated with FM-9 polymer to avoid droplet formation in the event of a crash are described. The device was based on a prototype model that could only process 6 l of fuel (antimisting kerosene - AMK). The main features of the degrader comprised an axial piston pump, a needle valve, and a pressure gage and transducer. Maximum flow rates of 1500 kg/hr were examined, the same as with a JT8D engine in cruise conditions. The fuel was heated and cooled to examine different ambient temperature conditions. The needle valve features a variable area orifice to maintain a constant pressure drop over a wide range of flow rates. Measurements were taken of the upstream flow pressure and the ignition of the fuel and it was found that AMK could be degraded to Jet A performance standards over any flight conditions, although degradation was more difficult in low-temperature conditions. M.S.K.

**A83-36243#
THERMAL STABILITY OF ALTERNATIVE AIRCRAFT FUELS**

J. TEVELDE, L. J. SPADACCINI, E. J. SZETELA (United Technologies Research Center, East Hartford, CT), and M. R. GLICKSTEIN (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, and ASME, Joint Propulsion Conference, 19th, Seattle, WA, June 27-29, 1983. 8 p. refs
(Contract N00140-80-C-0097)
(AIAA PAPER 83-1143)

A heated-tube apparatus was used to evaluate the thermal stability characteristics of four liquid hydrocarbon fuels and to determine the effect fuel deposits have on the heat transfer characteristics of aircraft gas turbine fuel systems. The fuels tested were: a low-aromatic JP-5, a blend of 80 percent JP-5 and 20 percent hydrocracked gas oil, a blend of 50 percent JP-5 and 50 percent No. 2 heating oil, and a shale derived JP-5. Deposit formation rates ranging from 10 to 3000 microgram/sq cm hr were obtained at tube wall temperatures ranging from 480 to 800 K, with peak formation rates occurring at initial surface temperatures of 644 to 672 K. Results indicate that deposit formation rate (1) correlates very well with initial surface temperature and (2) is relatively insensitive to fuel pressure in the range from 27.2 to 54.4 atm, and test duration in the range from 1 to 14 hr. The deposit thermal resistance, as calculated from heat transfer measurements, correlates well with measured deposit quantity and thickness. Author

A83-37960

OFFSHORE HELICOPTER OPERATIONS - GULF OF MEXICO
H. J. CHRISTIANSEN (FAA, Fort Worth, TX) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 9 p.
(SAE PAPER 821366)

Features of the FAA program, performed in concert with the NWS, to upgrade flight safety for operations serving oil and gas exploration and production facilities in the Gulf of Mexico are outlined. The onshore and offshore points number 2000 launching pads dealing with 850 helicopters and 4 million passengers annually. Since 1979, 25 IFR routes have been defined and use Loran C for navigation. Additionally, helicopters now use shipboard radar to approach and land on oil gas rigs. A visual flight rule aeronautical chart has been developed, as has military flight operations, procedures, and communications to upgrade the safety of military flight training operations in the area. Aviation weather conditions are now tracked by satellite. Finally, an avionics interface box between the Loran C receiver and VHF radio automatically transmits helicopter position coordinates to a Houston installation for displaying helicopter positions over the Gulf. M.S.K.

**A83-38004
TESTING OF ANTIMISTING KEROSENE IN THE DC-10/KC-10
FUEL SYSTEM SIMULATOR**

A. T. PEACOCK and F. Y. CHING (Douglas Aircraft Co., Long Beach, CA) Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 25-28, 1982. 11 p.
(SAE PAPER 821485)

The compatibility of antimisting kerosene (AMK) with a contemporary fuel system was evaluated. AMK made with the FM-9 additive to the base fuel was used throughout the program. Tests were conducted to determine the effects AMK had on the components and system performance, and the effects components and the system had on the fuel. Some DC-10/KC-10 systems are incompatible with the AMK fuel. Systems and/or procedural revisions to accommodate the AMK do not appear to present technically insurmountable problems. AMK reduces the performance of some systems below normally accepted levels. Additional studies and testing would be required to certify the aircraft fuel system for use with the FM-9 AMK. Author

**A83-38027
THE FORMATION OF NO(X) FROM NITROGEN-CONTAINING
ADDITIVES IN PREMIXED METHANE FLAMES**

D. CROWHURST and R. F. SIMMONS (University of Manchester Institute of Science and Technology, Manchester, England) Combustion and Flame (ISSN 0010-2180), vol. 51, July 1983, p. 289-298. refs

The conversion of fuel nitrogen to nitrogen oxides (NO + NO₂) in premixed methane flames containing nitrogen at concentrations approaching those found in polymers is investigated. Maximum concentrations of nitric oxide of up to 18,000 ppm were produced by the addition of ammonia, acetonitrile or pyridine to laminar methane-oxygen flames diluted with argon or nitrogen. Combustion occurred at equivalence ratios from 0.70 to 1.16 and final flame temperatures between 2000 and 2600 K. The conversion of nitrogen to NO(x) is found to be nearly quantitative for low concentrations of additive, but to approach a limiting value at high concentrations, which value decreased with increasing equivalence ratio and decreasing flame temperature. The formation of nitric oxide is explained in terms of a simple three-stage mechanism involving a nitrogen-containing intermediate, which is then used to derive an expression allowing the prediction of NO(x) levels for other hydrocarbon flames. A.L.W.

**A83-38028
NITRIC OXIDE FORMATION IN AN AMMONIA-DOPED
METHANE-OXYGEN LOW PRESSURE FLAME**

D. PUECHBERTY and M. J. COTTEREAU (Rouen-Haute-Normandie, Universite, Mont-Saint-Aignan, Seine-Maritime, France) Combustion and Flame (ISSN 0010-2180), vol. 51, July 1983, p. 299-311. refs

A83-38129

MINERAL AND ENERGY EXPLORATION IN YUGOSLAVIA - ACTIVITY OF THE IGCP PROJECT 143 WORKING GROUP

B. KOSCEC (Industrijski Projekt Co., Dept. of Complex Geological Explorations, Zagreb, Yugoslavia) (COSPAR, IUGS, URSI, IAGOD and AGID, Symposium and Workshop on Remote Sensing and Mineral Exploration, Ottawa, Canada, May 16-June 2, 1982) *Advances in Space Research* (ISSN 0273-1177), vol. 3, no. 2, 1983, p. 27-34. refs

This report on the activity of the Yugoslav IGCP Project 143 ('Remote Sensing and Mineral Exploration') Working Group consists actually of three parts. First part of it represents a summary of total Yugoslav Project 143 Group activities from year 1977-1982. Second part of the paper is dealing with a recent example of joint activity within the Project 143 Group, which resulted in a tectonical map of Mount Sara area, based on the interpretation of Landsat images. The third part shows results of detection of submarine gas seepages by thermal IR survey in the offshore area of Northern Adriatic and the relevant tectonic interpretation of Istra peninsula area

Author

A83-38135

REMOTE SENSING AND MINERAL EXPLORATION IN CHINA

G. YANG (China Geological Society, Beijing, People's Republic of China) (COSPAR, IUGS, URSI, IAGOD and AGID, Symposium and Workshop on Remote Sensing and Mineral Exploration, Ottawa, Canada, May 16-June 2, 1982) *Advances in Space Research* (ISSN 0273-1177), vol. 3, no. 2, 1983, p. 63-69. refs

In China, the use of aerial photography for geological applications began in the mid-1950s. From the beginning of the 1970s, remote sensing methods utilizing visible light and some bands beyond the visible light region were increasingly employed in geological research. The effectiveness of remote sensing became particularly apparent in connection with the widespread use of Landsat imagery. An atlas of composite color Landsat 1:1,000,000-scale images covering the entire territory of China was compiled. Applications of remote sensing are related to regional geological surveys, geotectonic research, reconnaissance studies concerning mineral deposits, hydrogeological surveys, environmental geology, and engineering geology. The use of Landsat images for the study of deposit-controlling geological conditions is considered along with the employment of Landsat imagery in connection with the delineation of oil-bearing structures.

G.R.

A83-38155

A STRATEGY FOR MINERAL AND ENERGY RESOURCE INDEPENDENCE

W. D. CARTER (U.S. Geological Survey, Reston, VA) (COSPAR, IUGS, URSI, IAGOD and AGID, Symposium and Workshop on Remote Sensing and Mineral Exploration, Ottawa, Canada, May 16-June 2, 1982) *Advances in Space Research* (ISSN 0273-1177), vol. 3, no. 2, 1983, p. 223-233, 235, 336. refs

The U.S. is relatively deficient in asbestos, chromium, fluorine, mercury, tin, and tungsten, all of which are crucial to a thriving and growing economy. Because of a variety of uncertainties related to purchases from foreign sources, it is prudent to develop a vigorous domestic exploration strategy which uses all the technological resources that are at hand. One of several approaches now available is the use of satellite data of various kinds including satellite image mosaics. The present investigation has the objective to show how a good data base and image mosaics can be used to develop an exploration strategy which can lead to the discovery of new mineral and energy resources. Aspects of past research are discussed, taking into account the Landsat 1.5,000,000-scale mosaic of the conterminous U.S. Attention is given to current research and research still needed. It is suggested that the use of satellite image maps (mosaics) from the Landsat series can help in developing a strategy for mineral and energy resource independence.

G.R.

A83-38337* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

COMPARING DIGITAL DATA PROCESSING TECHNIQUES FOR SURFACE MINE AND RECLAMATION MONITORING

R. G. WITT, B. G. BLY, W. J. CAMPBELL (NASA, Goddard Space Flight Center, Greenbelt, MD), H. H. L. BLOEMER (Ohio University, Athens, OH), and J. O. BRUMFIELD (Marshall University, Huntington, WV) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry Convention; APS Annual Meeting, 48th, Denver, CO, March 14-20, 1982, Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1982, p. 11-16

The results of three techniques used for processing Landsat digital data are compared for their utility in delineating areas of surface mining and subsequent reclamation. An unsupervised clustering algorithm (ISOCLS), a maximum-likelihood classifier (CLASFY), and a hybrid approach utilizing canonical analysis (ISOCLS/KLTRANS/ISOCLS) were compared by means of a detailed accuracy assessment with aerial photography at NASA's Goddard Space Flight Center. Results show that the hybrid approach was superior to the traditional techniques in distinguishing strip mined and reclaimed areas.

Author

A83-38343

EFFECTS OF PAST AND PRESENT SURFACE MINING OBSERVED THROUGH REMOTE SENSING TECHNIQUES

A. T. ANDERSON (U.S. Department of the Interior, Office of Surface Mining, Washington, DC) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry Convention, APS Annual Meeting, 48th, Denver, CO, March 14-20, 1982, Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1982, p. 317-322.

The Office of Surface Mining (OSM) has the primary goal to protect the environment and society from the adverse effects of coal mining operations, while insuring an adequate supply of coal to meet the Nation's energy needs. In connection with the responsibilities of the OSM, remote sensing and applied research play an important role. At present, OSM is involved in various direct or indirect efforts to examine, evaluate, implement, and transfer technology and techniques using different types of remote sensing data. A description is given of five remote sensing projects which OSM is now or has been involved with over the past 2 years. Attention is given to the aerial photographic monitoring of Appalachian coal regions, Western surface mine aerial coverage, subsurface mine fire detection, the photo interpretation manual of surface coal mining operations, and the development of a coal surface mine monitoring capability utilizing Landsat satellite technology.

G.R.

A83-38345

WIND POWER ASSESSMENTS AND REMOTE SENSING

P. A. MAULE, J. E. WADE, and C. L. ROSENFELD (Oregon State University, Corvallis, OR) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry Convention; APS Annual Meeting, 48th, Denver, CO, March 14-20, 1982, Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1982, p. 335-341. Research supported by the U.S. Department of Energy. refs

Research by the Wind Power Group (WPG) at Oregon State University has explored a variety of physical indicators of wind together with a variety of remote sensors. The WPG has developed a programmatic scheme of wind power prospecting with the experience of applying remote sensing to regional surveys.

Author

A83-38450

GLOBAL SATELLITE REMOTE SENSING FOR ENERGY, MINERALS AND OTHER RESOURCES

F. B. HENDERSON, III (Geosat Committee, Inc., San Francisco, CA) IN: International Society for Photogrammetry and Remote Sensing, International Symposium, Toulouse, France, September 13-17, 1982, Transactions. Volume 2. Toulouse, Groupement pour le Developpement de la Teledetection Aerospatiale, 1982, p. 179-183

Global digital and photographic data is expected in the late 1980s from civil remote sensing satellite systems, under development in the U.S., France and Japan, for the gathering of geological information pertinent to the development of both nonrenewable (energy and mineral) and renewable resources. Economically feasible global coverage will largely depend on the development of a cooperative ground receiving station network that can acquire, process, distribute and archive these data. Such a development program will involve the upgrading of 12 or more Landsat 1-3 ground receiving stations for the higher data rate processing capacity required by Landsat-4/TM, SPOT, and Japanese ERS data, together with the addition of regional cooperative stations covering the rest of the world. O.C.

A83-38622

THE LUNAR FACTORY [DIE MONDFABRIK]

H. H. KOELLE (Berlin, Technische Univesitaet, Berlin, West Germany) (Hermann-Oberth-Gesellschaft, Raumfahrtkongress, 31st, Bremen, West Germany, Sept. 16-19, 1982) Astronautik (ISSN 0004-6221), vol. 20, no. 3, 1983, p. 66-72. In German

Detailed design and feasibility studies of a lunar base for the production of construction materials and spacecraft fuel (mainly LOX) are reported. A primary market for the factory is seen in the construction and maintenance of a system of 100 geostationary solar/laser power converters. The design of a model factory with a projected life of 50 years (beginning around the year 2000) is developed, with functional concept, organizational structure, a ground plan, and sketches of buildings. The mass, energy, and information flows, manpower requirements, and desired output have been modeled mathematically as a system of 270 equations. The model factory requires 7000 metric tons of initial construction materials, with the personnel growing from 250 in the first year to 900 in the 50th year. A series of block diagrams and cost analyses are presented. It is shown that the high costs of lunar production (primarily due to the 600 earth/moon flights required per year) are outweighed by the savings (in transporting the output to earth orbit), so that the factory is economically viable with present (e.g., Space-Shuttle) propulsion technology. T K

A83-39126

REGRESSION-BASED ESTIMATION OF LONG-TERM MEAN AND VARIANCE OF WIND SPEED AT POTENTIAL AEROGENERATOR SITES

W. E. BARDSLEY (Waikato, University, Hamilton, New Zealand) and B. F. J. MANLY (Otago, University, Dunedin, New Zealand) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol. 22, Feb. 1983, p. 323-327. Research supported by the New Zealand Energy Research and Development Committee

A83-39181

COMPARISON OF RADIATIVE TRANSFER APPROXIMATIONS FOR A HIGHLY FORWARD SCATTERING PLANAR MEDIUM

M. P. MENGUC and R. VISKANTA (Purdue University, West Lafayette, IN) Journal of Quantitative Spectroscopy and Radiative Transfer (ISSN 0022-4073), vol. 29, May 1983, p. 381-394. Research supported by the Conoco, Inc. refs

The accuracy of the two-flux, spherical harmonics and discrete ordinates methods for predicting radiative transfer in a planar, highly-forward scattering and absorbing medium are critically examined. Numerical results for the radiative fluxes show that the two-flux and P3-approximations yield accurate results compared to solutions based on the FN-method. Indeed, these approximate methods are relatively simple and have potential for generalization to predict radiative transfer in multidimensional systems, as long

as an appropriate simplification of the phase function is utilized.

Author

A83-39992#

EFFECT OF USING EMULSIONS OF HIGH NITROGEN CONTAINING FUELS AND WATER IN A GAS TURBINE COMBUSTOR ON NOX AND OTHER EMISSIONS

P. P. SINGH, P. R. MULIK (Westinghouse Electric Corp., Pittsburgh, PA), and A. COHN (Electric Power Research Institute, Palo Alto, CA) ASME, Transactions, Journal of Engineering for Power (ISSN 0022-0825), vol. 105, July 1983, p. 430-437. Research supported by the Electric Power Research Institute. refs (ASME PAPER 82-GT-224)

A total of four combustion tests studying the response of various water/fuel emulsion rates on NOx emissions have been conducted on: (a) Paraho shale oil, (b) H-Coal (372x-522 K) distillate, (c) No 2 oil doped with quinoline, (d) H-Coal (505-616 K) distillate, utilizing a 0.14-m dia gas turbine can-type combustor at base-load conditions. Each test fuel run was proceeded with a base-line fuel run with No. 2 distillate oil. The results indicate that the effectiveness of water injection to reduce NOx decreased rapidly with an increase in the fuel-bound nitrogen (FBN) content of the test fuels. The smoke number, in general, decreased with increased water injection, while carbon monoxide and unburned hydrocarbons increased at high water/fuel flow rates. Author

N83-23308# Michigan Univ., Ann Arbor. Dept of Mechanical Engineering

EFFECT OF VOLATILITY ON AIR-FUEL RATION DISTRIBUTION AND TORQUE OUTPUT OF A CARBURETED LIGHT AIRCRAFT PISTON ENGINE Final Report

N. W. SUNG, K. MORRISON, and D. J. PATTERSON Atlantic City, N.J. FAA Mar. 1982 36 p refs (Contract DOT-FA79NA-6083)

(FAA-CT-82-117) Avail: NTIS HC A03/MF A01

A comprehensive sea level static test cell data collection and evaluation effort to review operational characteristics of a carbureted light aircraft piston engine as related to fuel volatility and air fuel ratio distribution to cylinders. Presented herein are results, data, and conclusions drawn from test cell engine operation on 100LL aviation grade fuel and various blends of automotive grade fuel. Sea level static test cell engine operations were conducted utilizing an AVCO Lycoming O-320 engine connected to an eddy current dynamometer which facilitated data collection under various engine load conditions. Test cell instrumentation was utilized to obtain operational data (temperatures, pressures, flow rates, torque, horsepower, exhaust emissions, etc.) from idle through cruise to maximum power with fuel grades having Reid vapor pressure of 6.7, 11.7 and 14.0. The primary purpose of test cell engine operation was to observe real time performance characteristics associated with automotive grade fuel utilized by piston powered light general aviation aircraft. Author

N83-23373# Rockwell International Corp., Canoga Park, Calif Energy Systems Group.

FLASH HYDROLIQUEFACTION OF COAL Quarterly Technical Progress Report, 4 Apr. - 3 Jul. 1981

24 May 1982 120 p refs (Contract DE-AC22-80PC-30018) (DE82-021594; DOE/PC-30018/3; ESG-DOE-13377QTPR-3) Avail: NTIS HC A06/MF A01

A reactor which allows rapid and uniform mixing of pulverized coal with heated hydrogen through the use of a rocket engine type injector was developed. The hydrogen is partially heated by indirect heating and further heated by partial combustion with oxygen to supply the required process heat. The amount of hydrogen fed is being kept as low as practicable because of the recycle implication for a complete process. Successful operation of a water cooled heat exchange quench unit without plugging or degradation was demonstrated. Char is separated from the vapor phase material in a separator which is maintained at a sufficiently high temperature to allow vapor phase removal of the liquid products. The effectiveness of the concept was demonstrated in

a series of tests. Substantial liquid yields and high overall conversions are possible. A high pressure product recovery system contains two condensers which split the liquid product into heavy and light oil fractions. DOE

N83-23374# Battelle Inst., Frankfurt am Main (West Germany) Fachbereich Produkt- und Verfahrensentwicklung
RESEARCH AND DEVELOPMENT WORK CONCERNING THE SEPARATION OF HELIUM FROM GAS MIXTURES BY SiO₂ COMPOSITE MEMBRANES Final Report, Oct. 1981

W. KREIGER and P. WIESSART Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 47 p refs /n GERMAN; ENGLISH summary (BMFT-FB-T-82-211; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Ger DM 10

Methods for the selective separation of helium from natural gas as an alternative to natural gas liquefaction was investigated. Composite membranes were examined for their usefulness for the separation of helium from a methane helium mixture. These composite membranes consisted of a polyimide film to which a thin silicon dioxide film was applied. A test apparatus was used for permeation measurements with helium, methane and a mixture of helium and methane at different temperatures and pressures. The permeation coefficients of helium and methane were determined, and the composition of the permeate was identified. It is found that helium is present in the permeate in a high concentration. E A K

N83-23378# Karlsruhe Univ (West Germany) DVGW-Forschungsstelle am Engler-Bunte Inst.
INVESTIGATIONS ON THE REMOVAL OF HYDROGEN FLUORIDE AND HYDROGEN CHLORIDE DURING THE TREATMENT OF COAL GASIFICATION GASES Final Report, Jun. 1981

B. R. RAO, H. LISCHER, H. KATZER, and K. HEDDEN Bonn Bundesministerium fuer Forschung und Technologie Dec 1982 64 p refs /n GERMAN; ENGLISH summary (BMFT-FB-T-82-238; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13,50

Impurities in coal such as fluorine and chlorine which are released as hydrogen compounds during gasification were investigated. The impurities have to be removed, at least partially, to prevent air pollution by combustion of such gases. Different analytical methods for hydrogen fluoride and hydrogen chloride were tested for their suitability of coal gasification gases and modified, due to disturbing accompanying components. The removal of hydrogen halides and ammonia by absorption with different solutions (water, ammonium chloride, calcium hydroxide and calcium hydroxide/calcium chloride solutions) was investigated in a bubble tray column. The complete removal of hydrogen chloride was achieved with all the solutions. It is found that the absorption efficiencies decrease during the simultaneous absorption of hydrogen chloride and ammonia. E A K

N83-23384# Delaware Univ., Newark Center for Catalytic Science and Technology.

KINETICS AND MECHANISM OF CATALYTIC HYDROPROCESSING OF COMPONENTS OF COAL-DERIVED LIQUIDS Quarterly Report, 16 Aug. 1981 - 15 Feb. 1982

B. C. GATES, J. R. KATZER, H. KWART, J. H. OLSON, G. C. A. SCHUIT, A. B. STILES, and L. PETRAKIS (Gulf Research and Development Co.) 26 Mar. 1982 31 p refs (Contract DE-AC22-79ET-14880) (DE82-019764, DOE/ET-14880/09, QR-10, QR-11) Avail: NTIS HC A03/MF A01

Heavy distillate derived from SRC-II coal liquid was separated into nine well-characterized fractions by preparative liquid chromatography. The neutral oils fraction is the most important fraction because it is the largest (73.5 wt % of the total) and the easiest to upgrade by hydroprocessing. Most of the sulfur in the heavy distillate is concentrated in this fraction. The hydroprocessing of this fraction was studied in a high-pressure plug flow microreactor

and a standard batch autoclave reactor using a standard commercial catalyst. Pseudo first-order rate constants were determined for the hydrodesulfurization of three sulfur-containing compounds. The effect of pressure was investigated in the range 120 to 150 atm. An experiment was done using the neutral oils fraction spiked with 4-methyldibenzothiophene. The results show that there is little hydrogenation even when hydrodesulfurization is almost complete. DOE

N83-23385# West Virginia Univ., Morgantown. Dept. of Chemical Engineering

ROLE OF C-CO SUB 2 IN GASIFICATION OF COAL AND CHAR Final Report, 15 Aug. 1978 - 15 Nov. 1981

J. T. SEARS and C. Y. WEN 1981 124 p refs (Contract DE-AC21-78ET-11338, ET-78-S-01-3253) (DE82-016392, DOE/ET-11338/1216) Avail: NTIS HC A06/MF A01

The objectives were to investigate coal-char gasification reactions with CO₂, H₂O and other gases, to examine fluid dynamics of char present in a fluidized bed, and to develop a computer model of the fluid-bed gasification which can incorporate such information. To these ends a unique high pressure/temperature thermogravimetric analysis instrument, a pressurized 30 cm-dia. fluid bed, and a high-temperature 13 cm fluid bed were constructed. Coal pyrolysis and char reactions were examined at temperatures to 1600 C and pressure to 28 atm. Extent of pyrolysis was shown to depend on particle size and pressure, and in three stages on temperatures. Char properties were determined, including diffusion coefficients of CO₂ in char and surface areas. Char reactivity does not strongly depend on pressure in the range 1 to 28 atm. Diffusion limits are strongly present above 1000 C. Fluid bed gasification can be modeled successfully, and a basic model is presented. DOE

N83-23386# State Univ. of New York, Binghamton Dept. of Chemistry

DESULFURIZATION WITH TRANSITION-METAL CATALYSIS Quarterly Progress Report, 27 Mar. - 27 Jun. 1982

J. J. EISCH Jul. 1982 5 p (Contract DE-FG22-81PC-40782) (DE82-019079, DOE/PC-40782/T2) Avail: NTIS HC A02/MF A01

The principal objective was to uncover new reagents and catalysts for upgrading coal-derived fuels by removing undesirable organosulfur, organonitrogen and, if feasible, organooxygen components. The following studies were initiated or continued: a study of the desulfurizing action of nickel, cobalt and copper salts, combined with metal hydrides, on SRC plant liquids; survey of the capability of low-valent nickel reagents to desulfurize, in one step, sulfones and other model organosulfur compounds; development of molybdenum-based desulfurizing agents; and exploration for denitrogenating agents suitable for quinolines and carbazoles. The following progress was made: nickel salts are superior to cobalt and copper salts in desulfurizing SRC liquids; in a two-step treatment, an SRC liquid was freed of 90% of its sulfur (0.5 to 0.05%), in ethereal solutions, vinylic and acetylenic sulfones can be reduced to sulfides by metal hydrides; inclusion of nickel salts gives some desulfurization, some butadiene-molybdenum complexes were synthesized. DOE

N83-23388# California Univ., Berkeley Lawrence Berkeley Lab. Dept. of Chemical Engineering.

OXYDESULFURIZATION OF COAL Ph.D. Thesis

G. A. CREMER, D. A. MIXON, S. ERGUN, and T. VERMEULEN May 1982 94 p refs (Contract DE-AC03-76SF-00098) (DE82-020980, LBL-14491) Avail: NTIS HC A05/MF A01

Pyrite, a principal sulfur-bearing component of high sulfur coals, reacts with oxygen to form ferric sulfate and sulfuric acid. By using these products as the reaction medium, the use of water is minimized, and the products are recoverable in essentially pure form. The reaction kinetics for oxidation of native pyrite and oxidation of pyrite in coal are compared in the range of 100 to

150 C, and it is concluded that acid iron sulfate media provide an effective means for inorganic sulfur removal. On the other hand, removal of organic sulfur is difficult to achieve without significantly lowering the heating value of the coal. Therefore the economic use of acidic oxidation is likely to be limited to coals in which pyrite comprises a large part of the total sulfur content. DOE

N83-23389# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.

EXPERIMENTAL INVESTIGATION AND PREDICTIVE MODELING OF THE ADSORPTION OF POLYCYCLIC AROMATIC HYDROCARBONS FROM WATER ONTO ACTIVATED CARBON
Annual Report, 1 Sep. 1980 - 31 Oct. 1981

R. W. WALTERS and R. G. LUTHY Jul. 1982 208 p refs
(Contract DE-FG22-80PC-30246)
(DE82-020723; DOE/PC-30246/1237; AR-1) Avail: NTIS HC A10/MF A01

Eleven of the sixteen polycyclic aromatic hydrocarbons (PAH) which appear on the US Environmental Protection Agency priority pollutant list were investigated with respect to adsorption onto activated carbon. Adsorption characteristics were examined in terms of PAH molecular and physiochemical properties. The partitioning behavior of PAH was investigated by generating adsorption isotherm data for eleven PAH from water onto Filtrasorb 400 activated carbon at 25 C using batch shake testing. An evaluation of the Henry's Law, Langmuir, BET, Freundlich and Redlich-Peterson adsorption isotherm equations indicated that the Langmuir equation most appropriately represents the data. Correlations which are presented here provide an understanding of the behavior of PAH in industrial process and treated wastewaters, and will assist the engineer or scientists in assessing the design of treatment systems for PAH removal DOE

N83-23390# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

PRELIMINARY ASSESSMENT OF CONDENSATION BEHAVIOR FOR HYDROCARBON-VAPOR EXPANSIONS WHICH CROSS THE SATURATION LINE NEAR THE CRITICAL POINT

O. J. DEMUTH Jul 1982 33 p refs
(Contract DE-AC07-76ID-01570)
(DE82-018095; EGG-GTH-5960) Avail: NTIS HC A03/MF A01

Analyses of binary cycles for conversion of geothermal energy from moderate temperature resources to electrical energy have shown potential gains in net geofluid effectiveness of on the order of 8%, resulting from selection of turbine expansion processes whose equilibrium states pass through the two phase region (assuming major condensation does not occur). If condensation occurs, this gain could be reduced or eliminated by the resulting loss in turbine efficiency. Experience with many fluids, however, indicates that vapor supersaturation (or subcooling) permits metastable pure vapor states to exist at temperatures considerably below the saturation temperature at a given pressure; thus, by better understanding the condensation process, and properly structuring the cycle, substantial performance gains may be achievable. The probability for attaining this performance gain is assessed. DOE

N83-23400# SRI International Corp., Menlo Park, Calif. Materials Research Lab.

MECHANISM OF CATALYTIC GASIFICATION OF COAL CHAR
Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1982

B. J. WOOD, B. L. CHAN, R. H. FLEMING, R. D. BRITAIN, K. M. SANCER, D. R. SHERIDAN, and H. WISE 21 Sep 1982 38 p refs
(Contract DE-AC21-80MC-14593)
(DE83-000416; DOE/MC-14593/T6; QTPR-7) Avail: NTIS HC A03/MF A01

A char gasification mechanism in which the catalyst reacts chemically with the carbon and also with the oxidizing gas to transfer reactive oxygen from the gaseous reactant to the char is discussed. The oxygenated carbon structure splits to yield CO, a major gasification product. Efforts aimed at elucidating some mechanistic details of this scheme are discussed. Since transfer

of electric charge between catalyst and char is a feature of the mechanism, the thermoelectric power of catalyst-impregnated carbon wafers were measured to identify the charge carrier type. The results show that, at steady state in an inert atmosphere, electron holes, probably in the carbon phase, are the majority charge carriers. However, during the initial interaction between the catalyst and the carbon, a transient condition exists in which the nature of the electrical transport process is not clear. The chemical mechanism of catalytic gasification of coal char is not yet understood. DOE

N83-23406# Texaco, Inc., Montebello, Calif.

GASIFICATION OF RESIDUAL MATERIALS FROM COAL LIQUEFACTION: TYPE-3 EXTENDED PILOT-PLANT EVALUATION OF A MOLTEN EXXON DONOR SOLVENT (EDS) LIQUEFACTION PROCESS RESIDUE FROM ILLINOIS NO. 6 COAL

A. M. ROBIN and H. L. YANG Aug. 1982 67 p
(Contract DE-AC01-76ET-10137; EX-76-C-01-2247)
(DE82-019929; DOE/ET-10137/T4; FE-1147-30) Avail: NTIS HC A04/MF A01

A type three extended pilot plant evaluation of EDS vacuum residue, which was obtained from the liquefaction of Illinois No. 6 coal at a coal liquefaction pilot plant, was successfully completed. A total of forty-four tons of EDS residue was gasified during five runs which were carried out at 1200 psig in the pilot plant residue gasifier. The solvent dilution levels, the steam to residue ratio and the oxygen to residue ratio were varied to determine optimum operating condition. A total of 97 hours of onstream time was accumulated. The longest continuous run was 28 hours. DOE

N83-23408# California Univ., Livermore. Lawrence Livermore Lab

PYROLYSIS KINETICS FOR WESTERN AND EASTERN OIL SHALE

A. K. BURNHAM, J. H. RICHARDSON, and T. T. COBURN (Kentucky Univ., Lexington) May 1982 7 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8 Aug 1982
(Contract W-7405-ENG-48)
(DE82-016002; UCRL-87587; CONF-820814-3) Avail: NTIS HC A02/MF A01

Oil yield and kinetic results are reviewed for Western (Colorado Mahogany zone) and Eastern (Sunbury and Ohio Cleveland member) oil shales for conditions ranging from those encountered in in-situ processing to those in fluidized-bed retorting. We briefly summarize kinetic models for the pyrolysis reactions. Oil yields from Eastern shale are much more sensitive to pyrolysis conditions than Western shale DOE

N83-23411# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

BIOMASS ELECTROCHEMICAL RESEARCH AT SERI

H. L. CHUM Jun. 1982 14 p refs Presented at the SERI Biomass Principal Invest. Rev. Meeting, Washington, D.C., 23-25 Jun. 1982
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-019101; SERI/TP-234-1650; CONF-820676-3) Avail: NTIS HC A02/MF A01

Electrochemical processing is being applied to biomass and derived materials to upgrade their energy content thereby generating fuels (or additives) or petrochemical substitutes, or increasing their reactivity and value for a variety of applications of the polymeric materials. The utilization of the following are addressed: (1) lignin polymers, which are not suitable substrates for anaerobic digestion to fuels and chemicals. The approach is to investigate relatively simple lignin derived materials which, in principle, can be produced in large quantities, and serve as models for the behavior of more complex materials. The lignin of choice is derived from an atypical and abundant hardwood such as aspen (*Populus tremuloides*), which has been pretreated by explosive depressurization (steam explosion) and is ethanol extracted. The aim is to change the degree of polymerization of these materials,

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and to increase their suitability as a replacement of phenol in phenol-formaldehyde thermosetting resins. DOE

N83-23412# Energy and Environmental Research Corp., Irvine, Calif.

SOOT FORMATION IN SYNTHETIC FUEL DROPLETS

G. ENGLAND, J. KRAMLICH, Y. KWAN, and R. PAYNE Aug. 1982 17 p

(Contract DE-AC22-80PC-30298)

(DE82-020992; DOE/PC-30298/T8; QTPR-7) Avail: NTIS HC A02/MF A01

This present research program investigates the details of soot formation from liquid fuel droplets and provides information on methods of minimizing soot formation during synthetic liquid fuel combustion under conditions which minimize the formation of nitric oxides. The program comprises two main tasks, Fuel Screening Studies and Flame Studies. The purpose of the first task is to investigate the impact of fuel properties on particulate production, to establish the importance of droplet size and examine atomizer effects, and to develop techniques for surrogate fuels production. In the second task, fundamental details of soot formation from synfuel droplet combustion will be investigated in variable slip velocity configurations. DOE

N83-23415# Bureau of Mines, Pittsburgh, Pa. Research Center.

FLAMMABILITY OF MIXED GASES

D. S. BURGESS, A. L. FURNO, J. M. KUTCHTA, and K. E. MURA Sep. 1982 25 p refs

(PB83-129510; BM-RI-8709) Avail: NTIS HC A02/MF A01 CSCL 21B

About 100 tests of flammability were carried out with H₂, CH₄, and CO in mixtures with air using the Federal Bureau of Mines 12-ft-diameter spherical pressure vessel as an explosion test chamber. The LeChatelier approximation gave slightly conservative estimates of the limits of downward flame propagation (onset of significant pressure rise) using the following measured values for the individual gases, in percent. H₂, 8.5; CH₄, 5.25; CO, 13.0. No justification could be offered for using the LeChatelier law for upward flame propagation limits and indeed reported data suggest that calculated values would not be conservative. The observed upward limit for methane-air mixtures (4.85 pct) was less than the widely accepted lean limit for this fuel; those for lean hydrogen-air mixtures and carbon monoxide-air mixtures did not differ from the lowest accepted values. Diffusional effects on the propagation of single, binary, and ternary fuel mixtures are discussed.

Author (GRA)

N83-23444# Electric Power Research Inst., Palo Alto, Calif.

PROCEEDINGS OF THE 2ND CONFERENCE ON ADVANCED MATERIALS FOR ALTERNATIVE-FUEL-CAPABLE HEAT ENGINES

May 1982 895 p refs Conf. held at Monterey, Calif., 24-28 Aug. 1981

(DE82-018875; EPRI-RD-2369-SR, CONF-810885) Avail: NTIS HC A89/MF A01

The problems that may be encountered by structural materials in heat engine systems burning alternative fuels are addressed. The problems for heat engines in the change to these different fuels are primarily related to impurities, both those whose role is chemical, in increasing the corrosion of materials, and those that appear as solid or liquid particles in the combustion gases and may erode or deposit on component surfaces. A difficulty is that the impurities that may be present in the newer fuels when they appear in the market cannot be predicted with confidence; both the amount and the nature of the impurities will be a function of the preparation methods. The principal areas of concern are gas turbines and diesels, but heat exchangers and direct combustion of coal are also discussed. Metallic materials, structural ceramics, and coatings are included; advanced cooling techniques, which may reduce problems of the interaction of the materials with their environment at the expense of greater fabrication problems, are also reviewed. DOE

N83-23464*# General Electric Co., Lynn, Mass. Aircraft Engine Business Group

ANALYTICAL FUEL PROPERTY EFFECTS, SMALL COMBUSTORS, PHASE 1 Final Report

J. D. COHEN Apr. 1983 32 p

(Contract NAS3-22829)

(NASA-CR-168138, NAS 1 26:168138, R82AEB078) Avail: NTIS HC A03/MF A01 CSCL 21D

The effects of nonstandard aviation fuels on a typical small gas turbine combustor was analyzed. The T700/CT7 engine family was chosen as being representative of the class of aircraft power plants desired. Fuel properties, as specified by NASA, are characterized by low hydrogen content and high aromatics levels. Higher than normal smoke output and flame radiation intensity for the current T700 combustor which serves as a baseline were anticipated. It is, therefore, predicted that out of specification smoke visibility and higher than normal shell temperatures will exist when using NASA ERBS fuels with a consequence of severe reduction in cyclic life. Three new designs are proposed to compensate for the deficiencies expected with the existing design. They have emerged as the best of the eight originally proposed redesigns or combinations thereof. After the five choices that were originally made by NASA on the basis of competing performance factors, General Electric narrowed the field to the three proposed.

Author

N83-23466# Douglas Aircraft Co., Inc., Long Beach, Calif.

COMPATIBILITY STUDY OF ANTIMISTING KEROSENE AND THE DC/KC-10 FUEL SYSTEM Final Report, Mar. 1981 - Apr. 1982

F. Y. CHING and A. T. PEACOCK Atlantic City FAA Mar. 1983 111 p refs

(Contract F33700-81-C-0057)

(FAA-CT-82-116) Avail: NTIS HC A06/MF A01

The compatibility of antimisting kerosene (AMK) with a contemporary fuel system was evaluated. AMK made with the FM-9 additive to the base fuel was used throughout the program. Tests were conducted to determine AMK effects on components and system performance, and component and system effects on the fuel. Some DC-10/KC-10 systems are incompatible with the AMK fuel. Systems and/or procedural revisions to accommodate the AMK do not appear to present technically insurmountable problems. AMK reduces the performance of some systems (e.g., jet pump transfer, gravity transfer, and suction feed) below normally accepted levels. Extensive study and testing will be required to certify the aircraft fuel system for use with the FM-9 AMK.

Author

N83-23470# Department of Energy, Bartlesville, Okla. Energy Technology Center.

FUELS/ENGINE INTERFACE RESEARCH: EDITED WORKSHOP PROCEEDINGS

D. W. BRINKMAN, ed Jul 1982 99 p Workshop held in Bartlesville, Okla., 22-23 Sep. 1981

(DE82-015614; CONF-8109137) Avail: NTIS HC A05/MF A01

The research needs at the interface between the fuels and engines industries as new fuels and new engine systems emerge is considered.

N83-23471# Suntech, Inc., Marcus Hook, Pa.

REFINING CURRENT FUELS FROM NEW RESOURCES

W. DOUTHIT /in DOE Fuels/Eng. Interface Res. p 21-27 Jul. 1982

Avail: NTIS HC A05/MF A01

The development of essentially current specification liquid fuels from new resources, research needs in utilizing such fuels, and the research roles that might be played by industry, universities, and government are addressed. Author

N83-23472# Conoco Coal Development Co., Stamford, Conn.
NEW FUEL TYPES
 R. G. JACKSON /n DOE Fuels/Eng. Interface Res p 28-35
 Jul. 1982
 Avail: NTIS HC A05/MF A01
 The state-of-the-art of the existing fuel/engine interface is addressed. Author

N83-23475# California Univ., Livermore. Lawrence Livermore Lab.
CHEMICAL-KINETIC PREDICTION OF CRITICAL PARAMETERS IN GASEOUS DETONATIONS
 C. K. WESTBROOK and P. A. URTIEW 12 Jan 1982 23 p refs Presented at the 19th Intern. Symp. on Combustion, Haifa, Israel, 8-13 Aug 1982
 (Contract W-7405-ENG-48)
 (DE82-007144; UCRL-87089; CONF-820801-3) Avail: NTIS HC A02/MF A01

A theoretical model including a chemical kinetic reaction mechanism for hydrogen and hydrocarbon oxidation is used to examine the effects of variations in initial pressure and temperature on the detonation properties of gaseous fuel-oxidizer mixtures. Fuels considered include hydrogen, methane, ethane, ethylene, and acetylene. Induction lengths are computed for initial pressures between 0.1 and 10.0 atmospheres and initial temperatures between 200 K and 500 K. These induction lengths are then compared with available experimental data for critical energy and critical tube diameter for initiation of spherical detonation, as well as detonation limits in linear tubes. Combined with earlier studies concerning variations in fuel-oxidizer equivalence ratio and degree of dilution with N₂, the model provides a unified treatment of fuel oxidation kinetics in detonations. DOE

N83-23479# General Electric Co., Philadelphia, Pa. Reentry Systems Div
COAL DESULFURIZATION BY A MICROWAVE PROCESS: TECHNICAL PROCESS REPORT
 P. D. ZAVITSANOS, J. A. GOLDEN, and K. W. BLEILER May 1982 23 p
 (Contract DE-AC22-80PC-30142)
 (DE82-016916; DOE/PC-30142/T4) Avail: NTIS HC A02/MF A01

Experiments were conducted to determine the effect of particle size and alkali concentration on the removal of sulfur and ash by microwave treatment of coal sampler mixed with sodium hydroxide, which was added as a concentrated water solution. Sulfur and ash reductions were measured as a function of NaOH to coal ratios (0.15 to 4) as well as coal particle size in the mesh range 30 by 200 to 200 by 0. Although the data was not analyzed in any detail, it appears that very good cleaning can be accomplished with relatively low concentrations of NaOH (13% to 37%). The particle size variation results suggest that the most mineral matter was removed from the finest coal sample (200 x 0). This statement is based on the fact that the (200 x 0) feed sample was least benefited by the float sink step (22% ash vs 9 to 15% for more coarse samples). As for the sulfur reduction, it is difficult to distinguish significant differences between 200 x 0 and 30 x 0 mesh sizes. DOE

N83-23481# Office of Technology Assessment, Washington, D.C.
INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS: ALTERNATIVES FOR REDUCING OIL IMPORTS
 Sep. 1982 297 p refs
 (PB83-126094; OTA-E-185) Avail: NTIS HC A13/MF A01
 CSCL 21D

Increased automobile fuel efficiency and synthetic fuels production are assessed and compared with respect to their potential to reduce conventional oil consumption, and their costs and impacts. Conservation and fuel switching as a means of reducing stationary oil uses are also considered, but in considerably

less detail, in order to enable estimates of plausible oil imports.

GRA

N83-23558# California Univ., Livermore. Lawrence Livermore Lab.
TESTS OF CRYOGENIC PIGS FOR USE IN LIQUEFIED GAS PIPELINES

D. L. HIPPLE and W. C. ONEAL 9 Sep 1982 60 p refs
 (Contract W-7405-ENG-48)
 (DE83-005028; UCRL-53320) Avail: NTIS HC A04/MF A01

Pipeline pigs are a key element in the design of a proposed spill test facility whose purpose is to evaluate the hazards of large spills of liquefied gaseous fuels (LGFs). A long pipe runs from the LGF storage tanks to the spill point, to produce a rapid spill, the pipe is filled with LGF and a pig will be pneumatically driven through the pipe to force out the LGF quickly and cleanly. Several pig designs were tested in a 6 inch diameter, 420 foot long pipe to evaluate their performance at liquid-nitrogen temperature and compare it with their performance at ambient temperature. For each test, the pig was placed in one end of the pipe and either water or liquid nitrogen was put into the pipe in front of the pig. Then pressurized drive gas, either nitrogen or helium, was admitted to the pipe behind the pig to push the pig and the fluid ahead of it out the exit nozzle. For some tests, the drive gas supply was shut off when the pig was part way through the pipe as a method of velocity control, in these cases, the pressurized gas trapped behind the pig continued to expand until it pushed the pig the remaining distance out of the pipe. DOE

N83-23568# United Technologies Research Center, East Hartford, Conn.
PARAMETRIC PERFORMANCE STUDIES ON FLUIDIZED-BED HEAT EXCHANGERS. TASK 1: FOULING CHARACTERISTICS
Yearly Technical Progress Report, 28 Jul. 1981 31 Jul. 1982
 R. C. STOEFLER Sep 1982 23 p refs
 (Contract DE-AC22-81PC-40280)
 (DE82-021005; DOE/PC-40280/T5) Avail: NTIS HC A02/MF A01

Analyses and experiments are being performed to investigate the heat transfer performance of single and multistage shallow fluidized beds for application to the recovery of heat from sources such as waste heat, and coal combustion or coal gasification. Tests were conducted to investigate the effects of liquid condensate fouling on fluidized bed heat exchanger performance. Liquid condensates used in these tests were water and glycerol (which is more viscous than water). The tests showed that fluidized bed heat exchanger performance is degraded by condensation within the bed and the degradation is caused by bed particles adhering to the heat exchanger surface, not by particle agglomeration. Liquid condensate did not continuously build up within the bed. After a period of dry out, heat transfer equal to that obtained prior to condensation was again obtained. DOE

N83-23576# Sandia Labs, Albuquerque, N. Mex.
IMPROVING THE DEPENDABILITY OF CRITICAL THERMOCOUPLE THERMOMETRY FOR FOSSIL-FUEL GASIFIERS AND RETORTS
 R. P. REED Jul 1982 54 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-020053; SAND-82-0341) Avail: NTIS HC A04/MF A01

Critical thermocouple thermometry is such a measurement in which either excessive error or loss of signal can result in unacceptable consequences. To avoid these consequences it is necessary that the thermometry survive whatever adverse environment accompanies the measurement; however, it is just as essential to accomplish definite, adequate, demonstrated accuracy. This report describes some of the more significant problems involved in applying thermocouple thermometry in hostile environments. For example a hostile environment is encountered in some locations in gasifiers and retorts, there sensor damage is likely. A model of defective thermocouples is used to describe several damage mechanisms, their effects on dependability, and the symptoms that allow their detection. The model illustrates why

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many significant errors can occur unrecognized and demonstrates the practical need for real-time validation diagnostics. Special continual diagnostic techniques are described that can help to establish the dependability of critical measurement throughout the period of use. DOE

N83-23619# Los Alamos Scientific Lab., N. Mex
DRILL-PIPE SEVERING TOOL WITH HIGH-TEMPERATURE EXPLOSIVE

S. P. KOCZAN, W. W. PATTERSON, and R. H. ROCHESTER
Aug. 1982 12 p refs
(Contract W-7405-ENG-36)
(DE82-021839; LA-9483-MS) Avail: NTIS HC A02/MF A01

A special purpose borehole explosive tool designed to meet a need of the hot dry rock (HDR) geothermal energy development program is described. The tool's purpose is to sever stuck drill pipe in deep (4500 m), hot (320 C), water filled wellbores. No commercial severing tools are known which can be operated at temperatures above 260 C. DOE

N83-23625# Fluor Engineers and Constructors, Inc., Irvine, Calif.

**COMPONENT FAILURE AND REPAIR DATA:
GASIFICATION-COMBINED-CYCLE POWER-GENERATION UNITS**

R. P. DAWKINS and J. A. DERDIGER Feb. 1982 156 p
(Contract EPRI PROJ. 239-2)
(DE82-902081; EPRI-AP-2205) Avail: NTIS HC A08/MF A01

Failure rates and average restore times are presented for generic types of equipment for a coal gasification combined cycle power generation plant. These were developed using published EEI data, a failure modes analysis procedure, and expert consensus method. The material was developed for use as input in assessing the reliability, availability, critical parts, and sensitivity to failure rates and repair time of a representative plant. These data are published separately because they present a complete and probably unique data set which it is believed will be found useful by other evaluators of such plants or subsystems. DOE

N83-23648# Department of Energy, Washington, D. C. Office of Energy Research

SUMMARIES OF PHYSICAL RESEARCH IN THE GEOSCIENCES

Sep. 1982 116 p refs
(DE82-021887; DOE/ER-0145) Avail: NTIS HC A06/MF A01

The scope of the individual research programs in geosciences are described. The geosciences research program includes research in geology, petrology, geophysics, geochemistry, hydrology, solar-terrestrial relationships, aeronomy, seismology, and natural resource analysis, including the various subdivisions and interdisciplinary areas. DOE

N83-23680# Los Alamos Scientific Lab., N. Mex
SEASAT-SATELLITE INVESTIGATION OF THE STRUCTURE OF WESTERN NEBRASKA AND ITS APPLICATION TO THE EVALUATION OF GEOTHERMAL RESOURCES

J. STIX Mar. 1982 18 p refs
(Contract W-7405-ENG-36)
(DE82-014128; LA-9275-HDR) Avail: NTIS HC A02/MF A01

SEASAT synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and, indirectly, the geothermal potential of an area in western Nebraska. Lineaments were mapped from the imagery and then compared to known structure. SEASAT does record surface manifestations of subtle basement structures, particularly faults and joints. Furthermore, two areas with hot dry rock geothermal potential were delineated using SEASAT and other data. More subsurface geology and geophysical data are needed before a final evaluation of the geothermal potential is made. SEASAT imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. DOE

N83-23683# Sandia Labs, Albuquerque, N. Mex.

MEASUREMENT OF FORMATION-RESISTIVITY CHANGES INDUCED BY IN SITU COMBUSTION

D. O. LEE and J. R. WAYLAND 1982 14 p refs Presented at the 57th AIME Soc. of Petroleum Engr. Ann. Tech. Conf. and Exhibition, New Orleans, 26 Sep. 1982
(Contract DE-AC04-76DP-00789)
(DE82-018975; SAND-82-0399C, CONF-820927-6) Avail: NTIS HC A02/MF A01

Use of controlled source audio magnetotelluric (CSAMT) techniques to map thermal fronts associated with enhanced oil recovery (EOR) processes depends upon knowledge of the changes in formation electrical resistivity. Measurement of these changes required the development of a technique which survives high temperatures and a very corrosive environment while measuring over a frequency range of 5 to 5000 Hz. The apparatus to make these measurements is described. The results from a laboratory forward dry combustion test in the University of Calgary combustion tube are presented. It is found that there is a two-decade change in the resistivity as the fire front traverses through a region. Also there are indications of the separate zones within a fire front. The importance of these results to interpreting CSAMT data are then considered. The frequency dependence of the resistivity changes suggests means of increasing CSAMT sensitivity for deep oil pay-zone mappings. DOE

N83-23684# CER Corp., Las Vegas, Nev.

WESTERN GAS SANDS PROJECT Status Report, Oct. - Nov. 1981

A. CRAWLEY (DOE, Bartlesville, Okla.) and C. H. ATKINSON Jul. 1982 109 p refs
(Contract DE-AC08-79BC-10003)
(DE82-019224; DOE/BC-10003/26) Avail: NTIS HC A06/MF A01

This WGSP Quarterly Report summarizes the progress of government-sponsored projects aimed at recovering gas from low permeability gas sands in the Western United States during October, November and December 1981. CK GeoEnergy released the final report for Development of Techniques for Optimizing Selection and Completion of Western Gas Sands. For CER's Reservoir Simulation Model Development, primary emphasis during the quarter was placed on extending the previous work to include effects of massive hydraulic fractures intersecting multiple lenses. During the quarter, the University of Oklahoma completed the two-dimensional reservoir simulator for BETC. A simplified two-dimensional hydraulic fracturing model is being developed by LLL. A major activity this quarter at Los Alamos was redesigning the NMR receiver system, making it capable of being repackaged for downhole use. DOE

N83-23685# Pennsylvania State Univ., University Park. Coal Research Section.

DATA BASE FOR THE ANALYSIS OF COMPOSITIONAL CHARACTERISTICS OF COAL SEAMS AND MACERALS Quarterly Technical Progress Report, May - Jul. 1981

A. DAVIS, N. H. SUHR, W. SPACKMAN, P. C. PAINTER, P. L. WALKER, and P. H. GIVEN Feb. 1982 76 p refs
(Contract DE-AC22-80PC-30013)
(DE82-012356; DOE/PC-30013/6) Avail: NTIS HC A05/MF A01

The first objective is to understand the systematic relationships between the properties of coals and the second is to determine the nature of lateral and vertical variability in the properties of a single seam. Five whole seam channel samples were collected from Illinois. Eighty-three coal samples and 120 printouts were provided on request to the coal research community. The equation $Q = 145 C + 610 H - 65 O - 20$ where Q is the calorific value, and C, H and O are the carbon, hydrogen and oxygen contents, respectively, appears to provide the best means of estimating calorific value from ultimate analyses of coals in the Penn State Coal Data Base. Trends in the lateral variability of petrographic composition of Lower Kittanning seam samples are presented. Distinct trends in the composition and properties within a single

coal seam enabled the areal changes in depositional environment and post-depositional metamorphic changes to be investigated.

DOE

N83-23687# Los Alamos Scientific Lab., N. Mex.

GEOHERMAL GRADIENT MAP OF THE CONTERMINOUS UNITED STATES

A. KRON and J. STIX 1982 4 p refs Presented at Ann. Geothermal Resources Council Meeting, San Diego, Calif., 11 Oct 1982

(Contract W-7405-ENG-36)

(DE82-015727, LA-UR-82-1434) Avail: NTIS HC A02/MF A01

The second edition of the Geothermal Gradient Map of the Conterminous United States is described and the changes made since the first edition are compared. The second edition of the map presents a compilation of over 1700 wells that have been measured for temperature below 50 m and whose temperature/depth profiles are linear, or composed of linear segments which reflect changes in the thermal conductivity of the rocks rather than hydrology. The data are displayed at an enlarged scale of 1:2,500,000 and in a format which shows the location, depth, and gradient of each well in a single color coded symbol. This edition contains over two times the amount of data shown on the first map and is accompanied by a table, listing for each well its location, depth, gradient, heat flow (where available), thermal conductivity (where available), and a reference. Over 200 references were consulted and are presented with the data.

DOE

N83-23691# National Academy of Sciences - National Research Council, Arlington, Va. Committee on Resource Evaluation.

ASSESSING MINERAL AND ENERGY RESOURCE POTENTIAL. A REPORT ON A WORKSHOP ON DATA REQUIREMENTS, DATA SOURCES AND ASSESSMENT METHODOLOGIES FOR EVALUATING UNDISCOVERED RESOURCES Final Report

Aug 1981 41 p refs

(PB83-107979) Avail: NTIS HC A03/MF A01 CSCL 081

Presentations on various resources are given. Data requirements for assessing the resource potential of each are given and appropriate data sources and assessment methodologies and techniques are discussed. Assessment data requirements and sources are emphasized. Assessment techniques are also discussed. The evaluation of geologic hazard potential in relation to resource potential assessments are discussed. Author (GRA)

N83-23692# National Academy of Sciences - National Research Council, Arlington, Va.

APPENDIX TO ASSESSING MINERAL AND ENERGY RESOURCE POTENTIAL: PROCEEDINGS OF A WORKSHOP ON DATA REQUIREMENTS, DATA SOURCES AND ASSESSMENT METHODOLOGIES FOR EVALUATING UNDISCOVERED RESOURCES Final Report

Aug 1982 407 p refs Workshop held at Denver, 26-28 Apr 1982

(PB83-107987) Avail: NTIS HC A18/MF A01 CSCL 081

An overview of the state-of-the-art of mineral and energy resource potential assessment is given. Data requirements, data sources, and assessment methodologies for evaluating undiscovered resource potential are discussed. Author (GRA)

N83-23786# Ruhrkohle Oel und Gas G m b.H., Bottrop (West Germany).

PLANNING, CONSTRUCTION AND OPERATION OF THE 35 MW SUB TH-TEST FACILITY FLINGERN FOR FIRING BITUMINOUS COAL IN AN ATMOSPHERIC FLUIDIZED BED FURNACE Final Report, Nov. 1981

H. G. KRISCHKE, R. W. CHALUPNIK, and H. P. MASUCH Bonn Bundesministerium fuer Forschung und Technologie Nov 1982 113 p refs In GERMAN; ENGLISH summary

(BMFT-FB-T-82-212; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 24

Clean combustion of high ash and high sulfur coal with the boiler, retrofitted from traveling grate stoker to FBC was

demonstrated. Within 4,200 operating hours 14,500 t of bituminous coal ranking from high grade to low grade were fired, generating 105,000 t of steam at 17 bar and 400 C. During the 18 month test operation important knowledge concerning process and systems to burn coal in the fluidized bed were gained. The technical feasibility in industrial scale was demonstrated. S. L.

N83-23794# Kepling and Associates, Inc., Tulsa, Okla.

THE IMPACT OF GEOLOGIC PARAMETERS ON ENHANCED OIL RECOVERY: WORKSHOP PROCEEDINGS

M. PETERSON, comp. May 1982 46 p refs Workshop held in Tulsa, Okla., 15-16 Oct. 1981

(DE82-012436; CONF-8110160) Avail: NTIS HC A03/MF A01

Reservoir anatomy and additional oil recovery, rock-fluid interactions, reservoir heterogeneity, reservoir description and instrument technology, and geologic input into EOR simulation techniques are discussed

N83-23795# Texas Univ., Austin. Bureau of Economic Geology.

RESERVOIR ANATOMY AND ADDITIONAL OIL RECOVERY

W. L. FISHER In Keplinger and Associates, Inc. The Impact of Geol. Parameters on Enhanced Oil Recovery p 8-13 May 1982

Avail: NTIS HC A03/MF A01

The ability to take detailed reservoir data and reconstruct in three dimensions the anatomy of a reservoir, that is, to define the plumbing of flow paths within the reservoir are addressed.

Author

N83-23797# Kepling and Associates, Inc., Tulsa, Okla.

RESERVOIR HETEROGENEITY WORKSHOP

In its The Impact of Geol. Parameters on Enhanced Oil Recovery p 19-23 May 1982

Avail: NTIS HC A03/MF A01

The adequacy of data and geologic models in the public domain in characterizing geologic heterogeneities of reservoirs, a model of heterogeneities based on surface geology (outcrop) to predict reservoir properties, interpretation of data from existing tools and improved tools for determining geologic heterogeneities, performance of fluid movement in heterogeneous media, minimizing effects of geologic heterogeneities on EOR, and the potential for infill drilling are summarized. Author

N83-23800# Kepling and Associates, Inc., Tulsa, Okla.

GEOLOGIC INPUT INTO EOR SIMULATION TECHNIQUES WORKSHOP

In its The Impact of Geol. Parameters on Enhanced Oil Recovery p 34-40 May 1982

Avail: NTIS HC A03/MF A01

The need for geologic input into reservoir simulation studies was addressed. Among the primary objectives of the workshop group were the development of a conceptual research and development program, the provision of public input into the DOE light oil program, and the identification of areas where new techniques and/or instrumentation could aid in quantifying needed geologic input data. Author

N83-23833# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

BIOTECHNOLOGY FOR THE PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS

R. H. VILLET, ed. Dec 1982 198 p refs Workshop held in Vail, Colo., 29 Sep - 2 Oct. 1980

(DE83-005500, SERI/CP-232-1520) Avail: NTIS HC A09/MF A01

The integration of scientific and process engineering which is required in the development of biotechnology was examined. Topics discussed are: fermentation of conventional feedstocks; conversion lignocellulose; algal biotechnology, and biotechnological process engineering and evaluation.

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N83-23834# Eidgenoessische Technische Hochschule, Zurich (Switzerland).

METABOLIC REGULATION OF YEAST

A. FIECHTER /In Midwest Research Inst. Biotechnol. for the Production of Chem. and Fuels from Biomass p 3-16 Dec. 1982 refs

Avail: NTIS HC A09/MF A01

Metabolic regulation which is based on endogeneous and exogeneous process variables which may act constantly or time dependently on the living cell is discussed. The observed phenomena of the regulation are the result of physical, chemical, and biological parameters. These parameters are identified. Ethanol is accumulated as an intermediate product and the synthesis of biomass is reduced. This regulatory effect of glucose is used for the aerobic production of ethanol. Very high production rates are thereby obtained. Understanding of the regulation mechanism of the glucose effect has improved. In addition to catabolite repression, several other mechanisms of enzyme regulation have been described, that are mostly governed by exogeneous factors. Glucose also affects the control of respiration in a third class of yeasts which are unable to make use of ethanol as a substrate for growth. This is due to the lack of any anaplerotic activity. As a consequence, diauxic growth behavior is reduced to a one-stage growth with a drastically reduced cell yield. The pulse chemostat technique, a systematic approach for medium design is developed and medium supplements that are essential for metabolic control are identified. E.A.K.

N83-23835# National Research Council of Canada, Ottawa (Ontario).

THE PROSPECTS FOR THE APPLIED GENETIC ENGINEERING OF YEAST

H. VANKEULEN and D. Y. THOMAS /In Midwest Research Inst. Biotechnol. for the Production of Chem. and Fuels from Biomass p 17-30 Dec. 1982 refs

Avail: NTIS HC A09/MF A01

The possibilities for genetically engineering into the yeast *Saccharomyces cerevisiae* new genes for the utilization of carbohydrates were examined. The present status of cloning vectors for yeast and their properties are reviewed. The development of methods for cloning new genes into yeast are described. The desirable features for the development of genetically modified yeasts for industry are discussed. E.A.K.

N83-23839# Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.

CLOSTRIDIUM THERMOCELLUM AS AN ETHANOL PRODUCER: ITS CHARACTERISTICS AND CURRENT AND FUTURE RESEARCH

R. F. GOMEZ /In Midwest Research Inst. Biotechnol. for the Production of Chem. and Fuels from Biomass p 65-70 Dec. 1982

(Contract EG-77-S-02-4198)

Avail: NTIS HC A09/MF A01

Ethyl alcohol which can be mixed with gasoline to obtain gasohol, a motor fuel that is as good as or better than gasoline is discussed. Ethanol can be made from ethylene derived from hydrocarbons or by fermentation of sugars derived from plant matter. Sugars derived from two classes of plant matter, starch and cellulose, can be fermented and distilled into ethanol. The conversion of cellulose to fermentable sugars and the fermentation of these sugars to ethanol in a single step which reduces capital costs is discussed. E.A.K.

N83-23840# Midwest Research Inst., Golden, Colo. Biotechnology Branch.

THERMOPHILIC DEGRADATION OF CELLULOSIC BIOMASS

T. NG and J. G. ZEIKUS (Wisconsin Univ.) /In its Biotechnol. for the Production of Chem. and Fuels from Biomass p 71-82 Dec. 1982 refs

Avail: NTIS HC A09/MF A01

The conversion of cellulosic biomass to chemical feedstocks and fuel by microbial fermentation is an important objective of

developing biotechnology. Direct fermentation of cellulosic derivatives to ethanol by thermophilic bacteria offers a promising approach to this goal. Fermentations at elevated temperatures lowers the energy demand for cooling and also facilitates the recovery of volatile products. In addition, thermophilic microorganisms possess enzymes with greater stability than those from mesophilic microorganisms. Three anaerobic thermophilic cocultures that ferment cellulosic substrate mainly to ethanol have been described. *Clostridium thermocellum*/*Clostridium thermohydrosulfuricum*, C. *thermocellum*/*Clostridium thermosaccharolyticum*, and C. *thermocellum*/*Thermoanaerobacter ethanolicus* sp. nov. The growth characteristics and metabolic features of these cocultures are reviewed. Author

N83-23847# Oak Ridge National Lab., Tenn. Chemical Technology Div.

FIXED-FILM COLUMNAR BIOREACTORS FOR THE PRODUCTION OF CHEMICALS AND FUELS FROM BIOMASS

C. D. SCOTT, S. E. W. SHUMATE, II, and E. J. ARCURI /In Midwest Research Inst. Biotechnol. for the Production of Chem. and Fuels from Biomass p 147-154 Dec. 1982 refs

Avail: NTIS HC A09/MF A01

Fixed films of an active biological agent are maintained on solid surfaces within bioreactor systems to allow high productivity without agent washout during continuous operation. This, coupled with a stagewise columnar arrangement, may allow higher overall reaction rates. Fluidized bed and fixed bed bioreactors with fixed films of microorganisms are studied for the production of chemicals and fuels from biomass derived feed materials. Ethanol production at high rates has been demonstrated with glucose as the feed material, methane and other chemicals are also produced in these advanced systems. Author

N83-23849# Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.

PRELIMINARY PROCESS ENGINEERING EVALUATION OF ETHANOL PRODUCTION FROM VEGETATIVE CROPS

A. R. MOREIRA, J. C. LINDEN, D. H. SMITH, and R. H. VILLET (Midwest Research Inst.) /In Midwest Research Inst. Biotechnol. for the Production of Chem. and Fuels from Biomass p 177-188 Dec. 1982 refs

Avail: NTIS HC A09/MF A01

Vegetative crops show good potential as feedstock for ethanol production via cellulose hydrolysis and yeast fermentation. The low levels of lignin encountered in young plant tissues show an inverse relationship with the high cellulose digestibility during hydrolysis with cellulose enzymes. Ensilaged sorghum species and brown midrib mutants of sorghum exhibit high glucose yields after enzyme hydrolysis as well. Vegetative crop materials as candidate feedstocks for ethanol manufacture should continue to be studied. The species studied so far are high value cash crops and result in relatively high costs for the final ethanol product. Unconventional crops, such as pigweed, kochia, and Russian thistle, which can use water efficiently and grow on relatively arid land under conditions not ideal for food production, should be carefully evaluated with regard to their cultivation requirements, photosynthesis rates, and cellulose digestibility. Such crops should result in more favorable process economics for alcohol production. Author

N83-23855# Sandia Labs., Albuquerque, N. Mex. Geophysics Div.

MAGMA ENERGY RESEARCH PROJECT Final Report

J. L. COLP. Oct. 1982. 34 p. refs

(Contract DE-AC04-76DP-00789)

(DE83-004761; SAND-82-2377) Avail: NTIS HC A03/MF A01

Scientific feasibility was demonstrated for the concept of magma energy extraction. The US magma resource is estimated at 50,000 to 500,000 quads of energy - a 700- to 7000-yr supply at the current US total energy use rate of 75 quads per year. Existing geophysical exploration systems are believed capable of locating and defining magma bodies and were demonstrated over a known shallow buried molten-rock body. Drilling rigs that can drill to the

depths required to tap magma are currently available and experimental boreholes were drilled well into buried molten rock at temperatures up to 1100°C. Downhole heat extraction equipment as designed, built, and demonstrated successfully in buried molten rock and in the very hot margins surrounding it. Two methods of generating gaseous fuels in the high-temperature magmatic environment - generation of H₂ by the interaction of water with the ferrous iron and H₂, CH₄, and CO generation by the conversion of water-biomass mixtures - were investigated and show promise.

DOE

N83-23857# California Dept. of Conservation, Sacramento. Div. of Mines and Geology.

RECONNAISSANCE GEOTHERMAL RESOURCE ASSESSMENT OF 40 SITES IN CALIFORNIA

E. LEIVAS, R. C. MARTIN, C. T. HIGGINS, and S. P. BEZORE
1981 251 p refs

(Contract DE-FG03-80SF-10855)

(DE82-022220, DOE/SF-10855-82/4; OFR-82-4-SAC) Avail:

NTIS HC A12/MF A01

Results are set forth for a continuing reconnaissance-level assessment of promising geothermal sites scattered through California. Involved is the acquisition of new data based upon field observations, compilation of data from published and unpublished sources, and evaluation of the data to identify areas suitable for more intensive area-specific studies. Forty sites were chosen for reporting on the basis of their relative potential for development as a significant resource. The name and location of each site is given, and after a brief synopsis, the geothermal features, chemistry, geology, and history of the site are reported. Three sites are recommended for more detailed on the basis of potential for use by a large number of consumers, large volume of water, and the likelihood that the resource underlies a large area

DOE

N83-23865# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy Lab.

MATERIALS FOR SYNGAS COOLERS Final Report

R. A. PERKINS, G. MORSE, and W. C. COONS Aug. 1982
187 p refs

(Contract EPRI PROJ. 1654-5)

(DE82-906452; EPRI-AP-2518) Avail: NTIS HC A09/MF A01

A technical basis for materials selection and laboratory testing of practical boiler tube materials which will provide reliable long term service in syngas coolers for coal gasification combined cycle power plants is outlined. The resistance of low alloy steel, stainless steels, and aluminum rich coatings to attack by a high sulfur, medium Btu coal gasification atmosphere was evaluated at 300 to 500 deg C. The materials may have adequate resistance for long time service in radiant coolers operating up to 500 deg C on high sulfur medium Btu gas. Performance is analyzed for thermodynamic and kinetic properties and recommendations for long term tests and development of protective coatings are presented.

DOE

N83-23886# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group.

PROCESS ENGINEERING AND MECHANICAL DESIGN REPORTS. VOLUME 2: PRELIMINARY DESIGN AND ASSESSMENT OF A 50,000 BPD COAL-TO-METHANOL-TO-GASOLINE PLANT

Aug. 1982 467 p 5 Vol.

(Contract DE-FC02-80ET-14759)

(DE83-000856; DOE/ET-14759/T1-VOL-2-14) Avail: NTIS HC

A20/MF A01

Units 11 to 39 of a coal-to-ethanol-to-gasoline fuel production plant are described. The design is basis given as are flowsheets and equipment lists. A risk assessment is included in each case.

DOE

N83-23887# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group.

PROCESS ENGINEERING AND MECHANICAL DESIGN REPORTS. VOLUME 3: PRELIMINARY DESIGN AND ASSESSMENT OF A 50,000 BPD COAL-TO-METHANOL-TO-GASOLINE PLANT

Aug. 1982 336 p 5 Vol.

(Contract DE-FC02-80ET-14759)

(DE83-000899; DOE/ET-14759/T1-VOL-3-14) Avail: NTIS HC

A15/MF A01

Auxiliary systems designs for a coal-to-methanol-to-gasoline production plant are given. Fine protection, waste disposal and treatment, and maintenance data are given.

DOE

N83-23888# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group.

PROCESS ENGINEERING AND MECHANICAL DESIGN REPORTS. VOLUME 5. PRELIMINARY DESIGN AND ASSESSMENT OF A 50,000 BPD COAL-TO-METHANOL-TO-GASOLINE PLANT

Aug. 1982 560 p 5 Vol.

(Contract DE-FC02-80ET-14759)

(DE83-000855; DOE/ET-14759/T1-VOL-4-14) Avail: NTIS HC

A24/MF A01

Equipment data sheets for a coal to methanol to gasoline production plant are given.

DOE

N83-23889# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group.

PROCESS ENGINEERING AND MECHANICAL DESIGN REPORTS. VOLUME 5: PRELIMINARY DESIGN AND ASSESSMENT OF A 50,000 BPD COAL-TO-METHANOL-TO-GASOLINE PLANT

Aug. 1982 541 p 5 Vol.

(Contract DE-FC02-80ET-14759)

(DE83-000866; DOE/ET-14759/T1-VOL-5-14) Avail: NTIS HC

A23/MF A01

Equipment data sheets and other data on automatic control equipment for a coal-to-methanol-to-gasoline fuel production plant are given. Data on operating panels, programmable logic controllers, and conveyor equipment are given.

DOE

N83-23893# Institute of Gas Technology, Chicago, Ill.

COAL CONVERSION SYSTEM TECHNICAL DATA BOOK

Aug 1982 336 p refs

(Contract DE-AC01-81FE-05157)

(DE83-000224; DOE/FE-05157/2) Avail: NTIS HC A15/MF A01

Sections of the Coal Conversion Systems Technical Data Book cover large coal deposits of the US coal rank, amount, proximate and ultimate analysis, sulfur, calorific value, swelling index, gas solids transport, fluidization, gas particulates separation (electrostatic precipitators, baghouses, cyclone separators, wet scrubbers, granular bed filters), and subject indexes for the whole data book.

DOE

N83-23898# Pacific Northwest Lab., Richland, Wash.

STEAM GASIFICATION OF WOOD IN THE PRESENCE OF CATALYSTS

L. K. MUDGE, D. H. MITCHELL, E. G. BAKER, R. J. ROBERTUS, and M. D. BROWN 1982 24 p refs Presented at the 14th Biomass Thermoconversion Contractors' Meeting, Arlington, Va., 23-24 Jun 1982

(Contract DE-AC06-76RL-01830)

(DE83-002071; PNL-SA-9954-REV-1; CONF-820685-3-REV-1)

Avail: NTIS HC A02/MF A01

Catalytic steam gasification of wood, including sawdust, chipped forest slash, and mill shavings, is investigated. Results of laboratory, process development unit (PDR), and feasibility studies illustrate attractive processes for conversion of wood to methanol and a substitute natural gas (SNG). Recent laboratory studies developed a long-lived alloy catalyst for generation of a methanol synthesis gas by steam gasification of wood. Modification of the PDU for operation at 10 atm (150 psia) is complete and initial tests are

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completed. The modified PDU will be operated at elevated pressures to confirm yields and design parameters used in process feasibility studies. A computer program for evaluating the effect of yield changes on process economics was completed. The base case was the study on economics of methanol-from-wood using catalytic gasification. It was found that methanol-from-wood by catalytic gasification was competitive with the process for methanol production from natural gas. DOE

N83-23905# Grace (W. R.) and Co., Memphis, Tenn. Agricultural Chemicals Group

TECHNICAL SUPPORT REPORT: PRELIMINARY DESIGN AND ASSESSMENT OF A 50,000 BPD COAL-TO-METHANOL-TO-GASOLINE PLANT

28 Apr. 1983 45 p refs

(Contract DE-FC02-80ET-14759)

(DE83-000904, DOE/ET-14759/T7-36) Avail: NTIS HC A03/MF A01

The technical support provided from process licensors, equipment suppliers, and consultants for use in the preliminary design of a coal-to-methanol-to-gasoline plant is discussed. Prime consideration was given to the selection of processes and equipment that was proven commercially. Support was given for pollution control, desulfurizing, water treatment, and environment effects. DOE

N83-23911# Sun Belt Energy Corp., Sardis, Miss.

FEASIBILITY STUDY OF A CORN-TO-ETHANOL PLANT IN SARDIS, MISSISSIPPI, VOLUME 2

Jun. 1982 117 p

(Contract FG07-81ID-12277)

(DE83-000806, DOE/ID-12277/T1-VOL-2) Avail: NTIS HC A06/MF A01

A technical description of a chemical processing facility capable of producing 5 million gallons per year of denatured anhydrous ethanol (power alcohol) is presented. In addition, certain equipment options are evaluated on the basis of availability, reliability, and budget constraints. Analysis of logistics and sensitivity of financial decision making criteria to market variables is not within the scope of this study. Consequently, concluding statements are limited to a discussion of technical feasibility and a statement of capital cost for turn key construction. DOE

N83-23912# Process Plants, Inc., Houston, Tex.

REPORT ON THE ENGINEERING AND ECONOMICS OF AN ETHANOL/GASOHOL JOINT-VENTURE PROJECT WITH CALDWELL SUGARS CO-OP, INC. AT THIBODAUX, LOUISIANA. ATTACHMENT A. VOLUME 1: DEFINITION OF FACILITIES AND SCOPE OF WORK FOR AN ETHANOL FACILITY TO BE LOCATED AT THIBODAUX, LOUISIANA

Apr. 1982 304 p

(Contract DE-FG07-81RA-50338)

(DE83-001166, DOE/RA-50338/1-VOL-1-ATTACH-A) Avail: NTIS HC A14/MF A01

A Lump Sum Proposal for engineering, procurement, and construction service for the ethanol plant is presented. The scope of work and process description are covered. The process description includes the process flow diagrams, equipment list, and piping and instrument diagrams. DOE

N83-23913# Institute of Gas Technology, Chicago, Ill.

SINGLE-STAGE FLUIDIZED-BED GASIFICATION

F. S. LAU, D. M. RUE, S. A. WEIL, and D. V. PUNWANI Apr. 1982 13 p refs Presented at 5th Tech. Conf. on Peat, Bethesda, Md., 27 Apr 1982

(DE83-900127; CONF-820453-3) Avail: NTIS HC A02/MF A01

The single-stage fluidized-bed gasification process, in addition to being a simple system, maximizes gas production and allows the economic exploitation of small peat deposits. The objective of this gasification project is to conduct experiments in order to obtain data for designing a single-stage fluidized-bed gasifier, and to evaluate the economics of converting peat to synthesis gas and to SNG by this process. An existing high-temperature and

high-pressure process development unit (PDU) was modified to permit the direct feeding of peat to the fluidized bed. Peat flows by gravity from the feed hopper through a 6-inch line to the screw-feeder conveyor. From there, it is fed to the bottom tee section of the reactor and transported into the gasification zone. Oxygen and steam are fed through a distributing ring into the reactor. Gasification reactions occur in the annulus formed by the reactor tube and a central standpipe. Peat ash is discharged from the reactor by overflowing into the standpipe and is collected in a solids receiver. DOE

N83-23914# Institute of Gas Technology, Chicago, Ill.

MEDIUM-BTU GAS FROM COAL BY THE IGT U-GAS PROCESS

A. REHMAT, M. K. VORA, and B. G. BRYAN 1982 16 p refs Presented at Am Inst. of Chem Engr Spring Meeting, Anaheim, Calif., 8 Jun. 1982

(DE82-022185; CONF-820610-12) Avail: NTIS HC A02/MF A01

The Institute of Gas Technology's (IGT) U-GAS process for medium-Btu fuel gas offers a means to produce a clean fuel from coal with minimal environmental impact. The U-GAS process uses an ash agglomeration mechanism in a single-stage fluidized bed coal gasifier to achieve high coal conversions. The U-GAS pilot plant has been operated since 1974 in support of the U-GAS process development. During this time, several types of coal and char have been successfully gasified with coal conversion efficiencies as high as 98.5%. In over 10,000 hours of total operation, 123 pilot plant tests have been completed with 1859 tons (1693 Mg) of coals gasified. Steady-state operations at pressures up to 60 psia (413 kPa) and temperatures up to 2000 F (1093 C) have produced a good quality fuel gas with a heating value as high as 284 Btu/SCF (10,579 kJ/cu m). Through this extensive testing and development program, the U-GAS process feasibility has been firmly established and an extensive data base acquired for scale-up. DOE

N83-23924# Alaska Univ., Fairbanks. Geophysical Inst.

PRELIMINARY GEOTHERMAL INVESTIGATIONS AT MANLEY HOT SPRINGS, ALASKA

J. EAST, E. WESCOTT, and D. L. TURNER Apr. 1982 85 p refs

(Contract DE-FC07-79ET-27034)

(DE82-020604, DOE/ET-27034/T1, UAG-R-290) Avail: NTIS HC A05/MF A01

Shallow, thermally disturbed ground at Manley Hot Springs constitutes an area of 1.2 km by 0.6 km along the lower slopes of Bean Ridge on the north side of the Tanana Valley. This area includes 32 springs and seeps and one warm (29.1 C) well. The hottest springs range in temperature from 61 to 47 C and are presently utilized for space heating and irrigation. The goal was to characterize the geothermal system present at Manley Hot Springs and delineate likely sites for geothermal drilling. Several surveys were conducted over a grid system which included shallow ground temperature, helium soil gas, mercury soil and resistivity surveys. In addition, a reconnaissance ground temperature survey and water chemistry sampling program was undertaken. The preliminary results, including some preliminary water chemistry, show that shallow hydrothermal activity can be delineated by many of the surveys. Three localities are targeted as likely geothermal well sites, and a model is proposed for the geothermal system at Manley Hot Springs. DOE

N83-23925# Arizona Bureau of Geology and Mineral Technology, Tucson. Geothermal Group.

PRELIMINARY ASSESSMENT OF THE GEOTHERMAL RESOURCE POTENTIAL OF THE YUMA AREA, ARIZONA

C. STONE 1981 27 p refs

(Contract DE-FC07-79ID-12009)

(DE82-021571; DOE/ID-12009/T3) Avail: NTIS HC A03/MF A01

The geothermal resource potential of the Yuma area of Arizona is discussed. The area is made up of low, rugged northwest trending mountains separated by deep sediment filled basins. Northwest

trending en-echelon faults bound the range fronts and the basins, and created several horst blocks (basement highs) that crop out at or near the surface. The Algodones fault is inferred to represent the northeast margin of the Salton Trough and apparently an inactive extension of the San Andreas fault system. Extensive well pumping and applications of irrigation waters in recent years have created an unnatural state of flux in the hydrologic regime in the Yuma area. Electrical resistivity values in the Bouse Formation are exceptionally low, about 3 ohm-m. Heat flow appears to be normal for the Basin and Range province. Ground water temperatures indicate zones of rising warm water, with one such warm anomaly confirmed by sparse geothermal gradient data.

DOE

N83-23928# Arizona Bureau of Geology and Mineral Technology, Tucson Geothermal Group.

GEOTHERMAL-RESOURCE POTENTIAL FOR A PORTION OF THE SAN PEDRO RIVER VALLEY

W. R. HAHMANN, SR. 1981 60 p refs

(Contract DE-FC07-79ID-12009)

(DE82-021852; DOE/ID-12009/T2) Avail: NTIS HC A04/MF A01

Three anomalous areas containing shallow-depth warm water were located in the San Pedro study area: the San Manuel-Mammoth area; the A.C. Gruwell Ranch; and Hookers Hot Springs at the Muleshoe Ranch. The probable explanation for these warm water resources is as follows. The Galiuro Mountains, the remains of a volcanic pile deposited along the axis of a large synform are in all probability an area of recharge for the ground water system in the area. The meteoric water falling down upon the Galiuro Mountains percolates downward to great depths through fractures in the volcanic rocks, becomes heated, rises by convection along faults, encounters later Tertiary sedimentary units overlying these faults and migrates laterally through these sediments out into the basin. These warm waters are now near the surface because of erosion of the late Tertiary and Quaternary sedimentary units by the San Pedro River

DOE

N83-23933# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

EVALUATION OF MATERIALS FOR SYSTEMS USING COOLED, TREATED GEOTHERMAL OR HIGH-SALINE BRINES

D. F. SUCIU and P. M. WIKOFF Sep. 1982 55 p refs

(Contract DE-AC07-76ID-01570)

(DE83-000653; EGG-2213) Avail: NTIS HC A04/MF A01

Lack of adequate quantities of clean surface water for use in wet (evaporative) cooling systems indicates the use of high-salinity waste waters, or cooled geothermal brines, for makeup purposes. High-chloride, aerated water represents an extremely corrosive environment. In order to determine metals suitable for use in such an environment, metal coupons were exposed to aerated, treated geothermal brine salted to a chloride concentration of 10,000 and 50,000 ppm (mg/L) for periods of up to 30 days. The exposed coupons were evaluated to determine the general, pitting, and crevice corrosion characteristics of the metals. Results indicate that ferritic stainless steels (29-4-2 and SEACURE) exhibit excellent corrosion resistance at all levels of chloride concentration. Copper-nickel alloys (70/30 and Monel 400) exhibited excellent corrosion resistance in the high-saline water. The 70/30 copper-nickel alloy, which showed excellent resistance to general corrosion, exhibited mild pitting in the 30-day tests.

DOE

N83-23934# Brookhaven National Lab., Upton, N. Y.
CATHODIC PROTECTION IN HIGHLY-AGGRESSIVE GEOTHERMAL ENVIRONMENTS

R. BANDY and D. VANROOYEN 1982 28 p refs Presented at Intern. Conf. on Geothermal Energy, Florence, 11 May 1982

(Contract DE-AC02-76CH-00016)

(DE82-021561; BNL-31737, CONF-820506-6) Avail: NTIS HC A03/MF A01

The feasibility of cathodic protection in highly aggressive geothermal environments were investigated using both impressed current and sacrificial anode techniques. Artificial brines simulating

the hypersaline geothermal brines and less aggressive geothermal fluids were used as test environments. Impressed current tests on carbon steel were conducted under controlled potential, and cathodic protection of carbon steel using zinc sacrificial anodes was studied by monitoring the galvanic current and potential of the couple with a zero resistance ammeter. Weight loss measurements were conducted in all cases to determine the amount of protection achieved. Results show that the weight loss generally follows a semilogarithmic relationship with the amount of potential shift away from the corrosion potential as a result of the impressed current. Under cathodic conditions, electrocrystallization was observed on the carbon steel surface, resulting in a small weight gain. For the carbon steel zinc couple, the potential gradually drifts towards that of the open circuit potential of zinc, resulting in protection for the steel and a relatively tolerable corrosion rate for zinc.

DOE

N83-23937# California Univ., Livermore. Lawrence Livermore Lab. Earth Sciences Div.

IDENTIFICATION OF FLUID-FLOW PATHS IN THE CERRO PRIETO GEOTHERMAL FIELD

S. E. HALFMAN, M. J. LIPPMANN, R. ZELWER, and J. H. HOWARD May 1982 4 p refs Presented at the Geothermal Resources Council Ann. Meeting, San Diego, Calif., 11-14 Oct. 1982

(Contract W-7405-ENG-48)

(DE82-018619; LBL-14534; CONF-821007-12) Avail: NTIS HC A02/MF A01

A hydrogeologic model of the Cerro Prieto geothermal field has been developed based on geophysical and lithologic well logs, downhole temperature, and well completion data from about 90 deep wells. The hot brines seem to originate in the eastern part of the field, flowing in a westward direction and rising through gaps in the shaly layers which otherwise act as partial caprocks to the geothermal resource.

DOE

N83-23948# Sandia Labs, Albuquerque, N. Mex. Geothermal Research Div.

MAGMA ENERGY RESEARCH PROJECT, FY80 ANNUAL PROGRESS REPORT Annual Progress Report

J. L. COLP, ed. Apr. 1982 109 p refs

(Contract DE-AC04-76DP-00789)

(DE82-021128; SAND-81-0100) Avail: NTIS HC A06/MF A01

The technical feasibility of extracting energy from magma bodies is explored. Five aspects of the project are studied: resource location and definition, source tapping, magma characterization, magma/material compatibility, and energy extraction

DOE

N83-23949# City of El Centro, Calif. Dept. of Public Works.

IMPERIAL COUNTY GEOTHERMAL DEVELOPMENT Progress Report, 1979-1982

Oct. 1982 29 p

(Contract DE-FC03-79ET-27196)

(DE83-002779; DOE/ET-27196/T8) Avail: NTIS HC A03/MF A01

The progress of geothermal development during the past 3 years, county activities in support of geothermal development, and current challenges and future needs of the geothermal industry and the county are summarized. Three additional Known Geothermal Resources Areas (KGRAs) were identified: the Westmorland KGRA, the East Brawley KGRA, and the South Brawley KGRA. Three 10 megawatt power plants began operations during the grant period. Three commercial power plants are scheduled to begin construction during late 1982 or early 1983. Site work was begun for the Heber Flash Power Plant. Two commercial power plants are in planning stages

DOE

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N83-23959# Southern Research Inst., Birmingham, Ala
EVALUATION OF PULSE ENERGIZATION ON A HOT-SIDE ELECTROSTATIC PRECIPITATOR Final Report

J. P. GOOCH, G. H. MARCHANT, JR., J. L. DUBARD, and J. R. MCDONALD Nov. 1982 88 p refs
(Contract EPA-68-02-2656; EPRI PROJ 1868-2)
(DE83-900742; EPRI-CS-2634) Avail NTIS HC A05/MF A01

The application of pulse energization to a hot side generating station precipitator are evaluated. The hot side precipitator had experienced performance degradation, which could be corrected by sodium sulfate conditioning of the coal. Pulsing systems were temporarily installed on the precipitator; the arrangement of pulsed fields was different on Sides A and B, and the two pulsing systems produced very different electrical pulse waveforms. When the unit had operated for seven days after washdown, with no sodium conditioning of the coal, the ESP performance had degraded to the point that the unit could not be operated at full load in compliance with local emissions standards, not even with both pulsing systems in operation. Thereafter, the unit was operated with minimal sodium conditioning, at the level of 0.7% Na₂O in the ash. With no sodium conditioning, the Method 17 mass sampling results indicated that penetration decreased from 3.33% to 1.57% on the B side, and from 3.76% to 1.68% on the A side as a result of pulsing. DOE

N83-23964# California Univ., Livermore Lawrence Livermore Lab.

RAMAN/FTIR SPECTROSCOPY OF OIL SHALE RETORT GASES

J. H. RICHARDSON, S. B. MONACO, R. H. SANBORN, T. B. HIRSCHFELD, and J. R. TAYLOR Aug. 1982 15 p refs
(Contract W-7405-ENG-48)
(DE82-021011, UCID-19547) Avail: NTIS HC A02/MF A01

A Raman facility was assembled in order to aid in the evaluation of the feasibility of using Raman or Fourier transform infrared spectroscopy for analyzing gas mixtures of interest in oil shale. Applications considered in oil shale research included both retort monitoring and laboratory kinetic studies. Both techniques gave limits of detection between 10 and 1000 ppm for ten representative pertinent gases. Both techniques are inferior as a general analytical technique for oil shale gas analysis in comparison with mass spectroscopy, which had detection limits between 1 and 50 ppm for the same gases. The conclusion of the feasibility study was to recommend that mass spectroscopic techniques be used for analyzing gases of interest to oil shale. DOE

N83-23966# Argonne National Lab., Ill Chemical Engineering Div.

ALKALI METAL VAPOR REMOVAL FROM PRESSURIZED FLUIDIZED-BED-COMBUSTOR FLUE GAS Quarterly Report, Oct. - Dec. 1981

I. JOHNSON and S. H. D. LEE May 1982 21 p refs
(Contract W-31-109-ENG-38)
(DE82-019233; ANL/FE-82-8) Avail NTIS HC A02/MF A01

A program to develop methods for cleanup of combustion gases from pressurized fluidized-bed coal (PFBC) combustors so that the cleaned gases can be used to power down-stream gas turbines without causing corrosion is discussed. A simulated PFBC flue gas was used in testing activated bauxite in a granular bed filter for its NaCl-vapor sorption performance at a bed temperature of 905 C and a system pressure of 10 atm absolute. Greater than 99.8% NaCl-vapor capture efficiency was achieved. Changes in the activated bauxite's chemical properties as a result of exposure to the simulated flue gas are described, and possible explanations for the changes are discussed. DOE

N83-23968# Olympic Associates Co., Seattle, Wash
LIQUID- AND SOLID-WASTE MANAGEMENT FOR COAL-CONVERSION PROCESSES Final Report

R. H. BOGAN, R. T. SKRINDE, and D. D. JECH Feb 1982 146 p refs
(Contract EPRI PROJ. 1658-02)
(DE82-902103, EPRI-AP-2245) Avail NTIS HC A07/MF A01

The results of a technical assessment of pollution control technology for liquid and solid wastes expected from coal conversion processes, are given. Treatment schemes which were proposed for four typical liquefaction and gasification processes are evaluated and promising alternative approaches are identified. Analytical methods applicable to coal conversion waste streams are reviewed and assessment is made of the potential for stricter environmental standards resulting from better analytical techniques in the future. The implications of more stringent standards are discussed, including means to achieve zero discharge of liquid effluents. State of the art treatment schemes are developed and detailed for each of four processes: Lurgi fixed bed gasification, Texaco entrained bed gasification, H-Coal catalytic liquefaction and Exxon Donor Solvent (noncatalytic) liquefaction. Various possible options for recycling of treated and untreated waste streams are identified for each process. DOE

N83-23969# Physical Dynamics, Inc., La Jolla, Calif
SOURCE-RECEPTOR RELATIONSHIP IN ACID PRECIPITATION: IMPLICATIONS FOR GENERATION OF ELECTRIC POWER FROM COAL Final Report

J. R. WIESENFELD (Cornell Univ.) and W. T. KREISS 1982 93 p refs
(Contract DE-FG01-81FE-16114)
(DE82-019307, PD-LJ-82-268R) Avail NTIS HC A05/MF A01

The conclusions of a technical panel convened to examine the source receptor relationship in acid precipitation are reported. While a decrease in acid deposition is certainly a worthy goal for pursuit, the ecological consequences with or without such decreases are uncertain. Assessment of the benefits to be derived (in terms of deposition abatement) from the imposition of emission controls remains a matter of significant uncertainty. A better understanding of the source receptor relationship must be gained in order to optimize the benefits of a major emission reduced program so that the likely benefits of alternative control strategies may be estimated with reasonable accuracy. Specific questions identified by the workshop panel as being of direct importance to the refinement of the source receptor relationship are related. DOE

N83-23974# State Univ. of New York, Stony Brook Marine Sciences Research Center

COAL-WASTE ARTIFICIAL-REEF PROGRAM, PHASE 4A

J. H. PARKER, P. M. J. WOODHEAD, I. W. DUEDELL, and H. R. CARLTON Sep 1982 361 p refs
(Contract EPRI PROJ. 1341-1)
(DE83-001249; EPRI-CS-2574) Avail: NTIS HC A16/MF A01

The environmental effects of disposing of fly ash and scrubber sludge in the ocean in the form of stabilized blocks is discussed. An artificial reef was constructed in the Atlantic Ocean with 500 tons of coal waste blocks on 12 September 1980. To detect potential environmental effects due to the presence of the reef and to determine the success of the coal waste blocks as a substrate for colonizing organisms, several biological studies were conducted. Results to date indicate that the blocks were colonized within weeks after placement in the ocean and the fish population was quickly established. The resident fish community was sampled and fish were tagged and released in order to estimate population size and rate of growth. Bioassays for toxicity were also conducted with sensitive life forms. The chemical behavior of the blocks exposed to seawater was monitored by determining the elemental composition and mineralogy of blocks retrieved from the reef site. DOE

N83-24011# California State Univ., Long Beach. Dept. of Geological Sciences

REPETITIVE PRECISION GRAVITY STUDIES AT THE CERRO PRIETO AND HEBER GEOTHERMAL FIELDS

R. B. GRANNELL Sep. 1982 104 p refs

(Contract DE-AC03-76SF-00098)

(DE83-004467; LBL-15073) Avail: NTIS HC A06/MF A01

To study subsidence and mass removal, a precise gravity network was established on 60 permanent monuments in the Cerro Prieto geothermal field in early 1978, and repeated annually through early 1981; the survey was tied to two bedrock sites outside the limits of the current production zone. The looping technique of station occupation was utilized, in which occupation of the base was followed by occupation of several stations, followed by a return to the base. Use of two LaCoste and Romberg gravity meters, and replication of values within loops as well as entire loops, enhanced precision such that the median standard deviations of the base-to-station differences, reduced to observed gravity values, ranged from 7 to 15 microgals for individual surveys. The smaller values were obtained as field and data reduction techniques were improved and experience was gained. A similar survey was initiated in the Heber area just north of the Mexican border in early 1980. It too was established on permanent monuments, was tied to bedrock stations outside the geothermal area, and used multiple repetitions of values with two meters to achieve high precision. DOE

N83-24016# Utah Univ., Salt Lake City

INTERPRETATION OF GEOPHYSICAL DATA FROM THE COLADO KGRA, PERSHING COUNTY, NEVADA

C. E. MACKELPRANG Apr. 1982 91 p refs

(Contract DE-AC07-79ID-12079)

(DE82-019937; DOE/ID-12079/58; ESL-71) Avail: NTIS HC A05/MF A01

The Colado geothermal area is evidenced by hot water wells in alluvium along the west flank of the West Humboldt Range. The exploration of this geothermal system has progressed into advanced stages with completion of shallow thermal gradient drilling, two intermediate depth exploration drill holes, one deep exploration drill hole, detailed geologic mapping, dipole-dipole resistivity, gravity, ground magnetics. MT-AMT, TDEM and assorted uncommon electrical resistivity techniques. A thermal anomaly was outlined by the shallow drilling. Dipole-dipole resistivity and gravity data along with detailed geologic mapping have suggested that this anomaly is structurally controlled. Other geophysical techniques employed do not appear to contribute to an understanding of the geothermal anomaly. The two intermediate depth exploration holes (IGH-1, IGH-2) and the one deep hole (44x-10) were not located in the most favorable portions of the geothermal anomaly. DOE

N83-24020# Cliffs Minerals, Inc., Rifle, Colo.

GEOLOGIC ANALYSIS OF DEVONIAN SHALE CORES

Feb. 1982 247 p refs

(Contract DE-AC21-78MC-08199)

(DE82-015003; DOE/MC-08199/T12) Avail: NTIS HC A11/MF A01

A description is given of the field retrieval and laboratory analysis of cores from the Devonian shales of the following eleven states. Michigan, Illinois, Indiana, Ohio, New York, Pennsylvania, West Virginia, Maryland, Kentucky, Tennessee and Virginia. The purpose was to explore these areas to determine the amount of natural gas being produced from the Devonian shales. The study included LANDSAT information, geochemical research, structural sedimentary and tectonic data. Field retrieval procedures, laboratory procedures, geologic analysis (by state), references, and appendices are given. DOE

N83-24022# Wyoming Univ., Laramie. Dept. of Geology and Geophysics.

HEAT-FLOW STUDIES IN WYOMING, 1979 TO 1982

E. R. DECKER, H. P. HEASLER, and K. L. BUELOW Dec. 1981 44 p refs

(Contract DE-FC07-79ID-12026)

(DE82-021739; DOE/ID-12026/T2) Avail: NTIS HC A03/MF A01

Thirty heat flow values completed during May 1981 for Wyoming are tabulated and updated maps of heat flow in Wyoming and adjacent areas are presented. DOE

N83-24023# Wyoming Univ., Laramie. Dept. of Geology and Geophysics.

HEAT FLOW, RADIOACTIVITY, GRAVITY, AND GEOTHERMAL RESOURCES IN NORTHERN COLORADO AND SOUTHERN WYOMING

E. R. DECKER and K. L. BUELOW Dec. 1981 27 p refs

(Contract DE-FC07-79ID-12026)

(DE82-020751; DOE/ID-12026/T1) Avail: NTIS HC A03/MF A01

The surface heat flow values in the Sierra Madre-Medicine Bow-Laramie Mountains region are in the range 0.6 to 1.5 HFU. When the heat from local bedrock radioactivity is considered, the reduced flux in these mountains is low to normal. These data and the low to normal gradients in the drill holes suggest that the resource potential of the Southern Rockies in Wyoming is low. The geothermal resource potential of the sedimentary basins in Wyoming that border these mountains also appears to be low. In contrast to southern Wyoming, the high surface and reduced heat flows suggest that the Park areas and other parts of the Southern Rockies in northern Colorado are potentially valuable geothermal resource areas. The narrow northerly borders of these positive anomalies suggest that some of the resources could be shallow, as does the evidence for regional igneous and tectonic activity in the late Cenozoic. DOE

N83-24024# Los Alamos Scientific Lab., N. Mex.

ROCK FAILURE DURING MASSIVE HYDRAULIC STIMULATION OF THE BACA LOCATION GEOTHERMAL RESERVOIR

C. PEARSON, H. KEPPLER, J. ALBRIGHT, and R. POTTER 1982 5 p refs

Presented at the Geothermal Resources Council Meeting, San Diego, Calif., 11-14 Oct. 1982

(Contract W-7405-ENG-36)

(DE82-018369; LA-UR-81-1578, CONF-821007-5) Avail: NTIS HC A02/MF A01

The analyses of microearthquake signals occurring during hydraulic stimulation provide an estimate of the size and location of the fractures thus produced. Studies of microearthquakes occurring during two large (1,000 cu m) hydraulic stimulations of the hydrothermal reservoir at the Baca Location in the Jemez Mountains of northeastern New Mexico are reported. Both stimulations consisted of water, viscosity enhancer, and proppant. The microearthquake event rate was low but variable throughout most of the treatment. Rock failure as indicated by the distribution of the microearthquakes' foci appeared restricted to a nearly vertical NE striking zone. This orientation is in good agreement with the local earth stresses inferred from geological considerations. The second stimulation which occurred in a neighboring well was similar to the first except for a larger injected volume. The lateral extent of the detected fracture system was 600 m in both stimulations. DOE

04 FUELS AND OTHER SOURCES OF ENERGY

N83-24025# Los Alamos Scientific Lab, N Mex
EVIDENCE OF FORMER HIGHER TEMPERATURES FROM ALTERATION MINERALS, BOSTIC 1-A WELL, MOUNTAIN HOME, IDAHO

B. ARNEY 1982 5 p refs Presented at Ann Geothermal Resources Council Meeting, San Diego, Calif., 11 Oct. 1982 (Contract W-7405-ENG-36)
(DE82-0118412; LA-UR-82-1710; CONF-821007-11) Avail: NTIS HC A02/MF A01

Cuttings from the silicic volcanics in the Bostic 1-A well near Mountain Home, Idaho were examined petrographically with the assistance of X-ray diffraction and electron microprobe analyses. Results indicate that these rocks were subjected to much higher temperatures than were observed in the well, when a static temperature log was run. It is not known to what extent the alternation may be due to greater depth of burial in the past, or whether it resulted from an early hydrothermal system of higher temperature than the one observed. DOE

N83-24259# Design Sciences, Inc., Sewickley, Pa.
FAULT TREE ANALYSIS REPORT

G. J. POWERS and S. A. LAPP Jun 1982 156 p refs
(Contract DE-AC02-80CH-10047)
(DE82-020754; DOE/CH-10047/4) Avail: NTIS HC A08/MF A01

Safety and reliability fault trees for the coal gasification process development unit (PDU) were constructed. Detailed fault trees with probability and failure rate calculations were generated for the events: fatality due to explosion, fire, toxic release or asphyxiation at the PDU coal gasification process; and loss of availability of the PDU. The trees were synthesized and subjected to multiple reviews. The steps involved in hazard identification and evaluation, fault tree generation, probability assessment, and design alteration are presented. The fault trees, cut sets, failure rate data and unavailability calculations are included. DOE

N83-24316# Ruhrkohle Oel und Gas G.m.b.H., Bottrop (West Germany).

PROTOTYPE PANT FOR NUCLEAR PROCESS HEAT (PNP). VERIFICATION OF RUHRKOHLE'S AG'S INTERESTS Final Report, Mar. 1982

R. DUERNFELD and G. KRAUT-GIESEN Bonn
Bundesministerium fuer Forschung und Technologie Nov. 1982 40 p /in GERMAN; ENGLISH summary
(BMFT-FB-T-82-213, ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8,50

The realization of nuclear coal gasification with a nuclear high temperature reactor (HTR) in accordance with the technical status as well as meeting the existing safety regulations seems to be feasible. Research and development is needed for affirmation of design. The gasification of hard coal basing on the autothermal principal is possible. The design work for the pilot plant should be started immediately, particularly keeping in mind the decision for erection of PNP in 1990. The calculation of production costs in comparison to autothermal gasification processes is promising better economics, if uncertainties of investment calculation are deemed to be neglectable. S.L.

N83-24592# Washington State Univ., Pullman. Dept of Mechanical Engineering
EVALUATION OF A RECTANGULAR OPPOSED-JET BURNER FOR PULVERIZED-COAL DIFFUSION-FLAME STUDIES

A. M. ZGHOUL, R. N. COMSTOCK, and W. L. GROSSHANDLER Apr. 1982 29 p refs Presented at the Spring Meeting of the Western States Sect. of the Combustion Inst., Salt Lake City, 12 Apr. 1982
(Contract DE-FG22-80PC-30216)
(DE82-009791; CONF-820403-3) Avail: NTIS HC A03/MF A01

An experimental facility which consisted of an opposed flow burner, a fluidized bed particle feeder, and analyzers for particle velocity and gas composition determination, was developed for performing pulverized coal diffusion flame studies. The extent to

which the flame is two dimensional under actual experimental condition was determined, and the rectangular opposed flow diffusion flame (OFDF) was assessed to determine if it may be a useful experimental tool for studying the combustion of pulverized coal. The design and operation of the test facilities are described. The test results showed that: the rectangular OFDF burner provides a long pathlength over which the temperature and composition remain constant, thus making it ideal for line of sight optical measurements; the temperature and composition of stable species varies almost exclusively with the distance perpendicular to the flame front, and the structure is similar to that of an axisymmetric OFDF. DOE

N83-24595# California Univ., Livermore Lawrence Livermore Lab.

URANIUM FROM SEAWATER

D. GREGG and M. FOLKENDT 21 Sep 1982 39 p refs
(Contract W-7405-ENG-48)
(DE83-000658; UCID-1969) Avail: NTIS HC A03/MF A01

A process for recovering uranium from seawater is proposed and some of the critical technical parameters are evaluated. The process, in summary, consists of two different options for contacting adsorbent pellets with seawater without pumping the seawater. It is expected that this will reduce the mass handling requirements, compared to pumped seawater systems, by a factor of approximately 1,000, which should also result in a large reduction in initial capital investment. Activated carbon, possibly in combination with a small amount of dissolved titanium hydroxide, is expected to be the preferred adsorbent material instead of the commonly assumed titanium hydroxide alone. The activated carbon, after exposure to seawater, is stripped of uranium with an appropriate eluant (probably an acid) or is burned for its heating value (possible in a power plant) leaving the uranium further enriched in its ash. DOE

N83-24596# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

CRITICAL STUDIES OF THE RAPID PYROLYSIS AND HYDROLYSIS OF COAL Final Project Report, 1 Jan. 1977 - 30 Jun. 1982

J. B. HOWARD and W. A. PETERS Sep. 1982 13 p
(Contract DE-AT01-76ET-10693, EX-76-A-01-2295)
(DE83-000101, DOE/ET-10693/2295; FE-MIT-2295T26) Avail: NTIS HC A02/MF A01

The effects of reaction conditions on the rapid pyrolysis behavior of coal in inert and hydrogen atmospheres are summarized. The independent effects of final temperature (150 to 1100 C), reaction time at final temperature (0 to 30 s), heating rate (10 to 10,000 C/s), total pressure (0.0001 to 100 atm), hydrogen partial pressure (0 to 69 atm), and particle size (45 to 1000 microns), on product yields and compositions were determined for a Montana lignite and a Pittsburgh No. 8 Seam bituminous coal. Kinetic data were obtained for formation of specific pyrolysis products from each coal. A new mass transfer model for rapid hydrogasification of softening coal was also formulated. Effects of native mineral matter and selected inorganic additives on the pyrolysis behavior of the Pittsburgh Seam coal and of a Wyodak subbituminous coal were also studied. DOE

N83-24597# SRI International Corp., Menlo Park, Calif.
IDENTIFICATION AND CLEAVAGE OF BREAKABLE SINGLE BONDS BY SELECTIVE OXIDATION, REDUCTION, AND HYDROLYSIS Quarterly Report, 1 Apr. - 30 Jun. 1982

A. S. HIRSCHON, J. ZEVELY, and F. R. MAYO Sep. 1982 41 p refs
(Contract DE-AC22-78ET-11423, DE-22-81ET-11423)
(DE82-021276; DOE/ET-11423/T5, QR-15) Avail: NTIS HC A03/MF A01

The structure of bituminous coal was studied. The program began with studies of the fraction of Illinois No. 6 coal that is toluene-insoluble, pyridine-soluble (TIPS). Investigations of TIPS fractions, the preparation of a lot, their fractionation by gel permeation chromatography, and their oxidations by aqueous

NaOCl and Ce(IV) is described. It is shown that benzylamine dissolves only 1.3% of the carbon in pyridine-extracted coal in 5 extractions (4h), but 7.3% in 16 days. A concentrated benzylamine extract was almost wholly soluble in pyridine. Increases in hydroxyl and amine groups when coal is extracted by N-containing solvents, are compared. Silylation of TIPS fractions soluble and insoluble in alcoholic KOH results in similar hydroxyl contents differing in molecular weight. Black acids were tested for diaryl ketone. A literature review indicates that in connecting links Ar-(CH₂)/sub n/-Ar in coal liquefaction, n should be 2 or more. Pyridine extractions of nine coals are summarized. DOE

N83-24598# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center

GAS CHARACTERIZATION FROM FLUIDIZED-BED COAL GASIFICATION Quarterly Report, 1 Mar. - 31 May 1982

D. F. CILIBERTI, E. E. SMELTZER, N. T. ROHATGI, M. A. ALVIN, D. L. KEAIRNS, A. B. TURNER, F. LAGONIK, and D. LOJEK 1982 43 p

(Contract DE-AC21-81MC-16024)

(DE82-021179, DOE/MC-16024/T3, QR-3) Avail NTIS HC

A03/MF A01

The characterization of the nature of alkali, trace metal, particulate, and hydrocarbon emissions in the hot fuel gas stream produced in a fluidized bed gasifier is proposed. The potential environmental and process implications of these emissions are sought. The characterization is to consist of determining the amounts of contaminants associated with the particulate emissions relative to the amounts and types of gaseous species. The particulate-associated contaminants will be further analyzed to determine their soluble and insoluble fractions as well as the particular species present. The primary method of sampling will be based on isokinetic extractive sampling. Upon analysis of the species and amounts of alkali, trace metal, and hydrocarbons found, attempts will be made to correlate the effects of feedstocks and operating parameters with these emissions. This will be used to develop a basis for projecting emission profiles in fluidized bed gasification processes. DOE

N83-24599# Physical Sciences, Inc., Andover, Mass.

EFFECTS OF PREIGNITION ON PULVERIZED-COAL COMBUSTION Quarterly Report, 1 Apr. - 30 Jun. 1982

G. A. SIMONS, G. KOTHANDARAMAN, S. P. SCHERTZER, and M. J. PALM 1982 60 p refs

(Contract DE-AC22-80PC-30293)

(DE82-020517, DOE/PC-30293/7, PSI-TR-334; QR-7) Avail

NTIS HC A04/MF A01

Pore structure optimization, is complete. The results predict that high reactivity chars require high porosities and a higher concentration of large pores. The experimental studies illustrate the dependence of these quantities on heating rate and final temperature. The data obtained for Texas Lignite suggest that porosity (hence reactivity) is strongly dependent on the final pyrolysis temperature with the maximum porosity occurring at 1300 K. The data also indicate that to a lesser extent, the heating rate affects pore structure. Higher heating rates increase the relative number of large pores and thus can enhance reactivity by a factor of two. Hence, the optimum pore structure for char reactivity may be obtained by preparing char at 1300 K and high heating rates (1000 K/s). Such chars could be four times as reactive as chars prepared at 2000 K and 1 to 10 K/s. The theory of pore evolution is complete and was reported. DOE

N83-24600# Pittsburgh and Midway Coal Mining Co., Shawnee Mission, Kans.

LIQUEFACTION OF BITUMINOUS COALS WITH ADDED CATALYSTS

Sep. 1982 94 p refs

(Contract DE-AC22-81PC-40005; DE-AC22-79ET-14800)

(DE83-000309; DOE/PC-40005/20) Avail NTIS HC A05/MF

A01

Catalyst addition studies were carried out during solvent refined coal (SRC) 1 and SRC 2 processing of bituminous coals. While

these coals can generally be liquefied successfully in both modes of operation, the catalysts were added in an attempt to improve yields, product quality and operability. At 450 C, 2250 psig and 1.0 hour residence time in the SRC 2 mode with Loveridge coal, two hydrodesulfurization catalysts (NiMo and CoMo on alumina) and an ammonium molybdate emulsion increased total oil yield by 10 wt % (based on MF coal). Molybdenum added by aqueous impregnation of the coal, pyrite and ferric oxide each increased oil yield by about 6 wt %, while a ferrous sulfate emulsion had little effect. Distillate product analyses were not changed by the additives except for a reduction in sulfur with the molybdenum catalysts. There was a significant improvement in operability with all additives except the ferrous sulfate emulsion. DOE

N83-24601# Mobil Research and Development Corp., Paulsboro, N.J.

ANALYTICAL STUDIES FOR THE H-COAL PROCESS Final Report

M. BECKER, J. G. BENDORAITIS, M. G. BLOCH, A. V. CABAL, R. B. CALLEN, L. A. GREEN, F. J. HILLS, C. A. SIMPSON, and J. C. TREWELLA Jul 1982 121 p refs

(Contract DE-AC05-77ET-10112; EF-77-C-01-2676)

(DE82-019835; DOE/ET-10112/T1, FE-2676-8) Avail NTIS HC A06/MF A01

H-coal Syncrude product streams, prepared from Illinois No. 6, Wyodak, or West Kentucky No. 11 coal were obtained from the H-Coal Process Development Unit (PDU) and analyzed for physical properties, elemental compositions, trace metal levels, and molecular composition. The trace metal levels are generally low in all except the heavy fuel oils. Although the product streams bear some similarity to comparable petroleum streams, they differ in that, for example, the H-Coal non-aromatic cuts are more naphthenic, and the aromatic cuts account for a higher proportion of the streams. The naphthas contain predominantly cyclic compounds which upon catalytic reforming should yield high octane gasoline. However, coal liquids contain significant amounts of highly polar compounds. In the naphthas these compounds are mainly phenols, anilines, and pyridines, which would need to be removed prior to use as gasoline. After storage for one year solids formed in all products, generally increasing with time and temperature. Naphtha gum levels also increased. Most of the other changes were relatively minor. DOE

N83-24602# Babcock and Wilcox Co., Alliance, Ohio Research and Development Div

COMPUTATIONAL TOOLS FOR PULVERIZED-COAL COMBUSTION Quarterly Report, Apr. - Jun. 1982

W. J. OBERJOHN, D. K. CORNELIUS, W. A. FIVELAND, R. J. SCHNIPKE, and J. H. WANG Jan 1982 26 p refs

(Contract DE-AC22-81PC-40265)

(DE82-021387; DOE/PC-40265/5; ARC-5274; QR-5) Avail

NTIS HC A03/MF A01

A computer code capable of modeling the major aspects of pulverized coal combustion was developed. Achieving this objective will lead to design methods applicable to industrial and utility furnaces. The combustion model consists of a number of relatively independent modules that represent the major processes involved in pulverized coal combustion. These modules will be continually upgraded. The initial evaluation of the gas phase models continued, the definition of the solid phase models was completed, and coding was initiated. A swirling flow, gas phase combustion evaluation run was completed and good agreement was obtained with predictions from a proprietary code based on similar models of the physics and chemistry. A nonswirling gas phase combustion run was completed. DOE

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N83-24604# California Univ., Livermore. Lawrence Livermore Lab.

METHOD FOR INITIATING AN UNDERGROUND COMBUSTION PROCESS

D. S. THOMPSON and D. F. SKINNER, JR. 2 Jul 1982 6 p refs Presented at the 8th Underground Coal Conversion Symp., Keystone, Colo., 15 Aug 1982 (Contract W-7405-ENG-48) (DE82-020164, UCRL-87789, CONF-820840-2) Avail NTIS HC A02/MF A01

The product of an effort at the Lawrence Livermore National Laboratory aimed at the initiation of a stable combustion process at either end of a process channel is a silane/propane ignition system that was taken through the design, testing, and field operation sequence, yielding an improvement in performance over previous techniques. Pyrophoric silane provides the ignition source, and propane (or methane) serves as the sustaining fuel to ignite the coal seam. The system performed satisfactorily at the base of vertical and horizontal wells in a coal seam; it was also used to ignite remotely a pilot burner in an incinerator. Other applications are being suggested. DOE

N83-24605# California Univ., Livermore Lawrence Livermore Lab.

TECHNICAL UNDERGROUND-COAL-GASIFICATION SUMMATION: 1982 STATUS

D. R. STEPHENS, C. B. THORSNESS, R. W. HILL, and D. S. THOMPSON Jul 1982 20 p refs Presented at the 8th Underground Coal Conversion Symp., Keystone, Colo., 15 Aug. 1982 (Contract W-7405-ENG-48) (DE82-020160; UCRL-87689, CONF-820840-1) Avail. NTIS HC A02/MF A01

The eighteen field tests and ten years experience have demonstrated technical feasibility and allow several generalizations concerning underground coal gasification. For example, burns tend to be bowl shaped after roof collapse, since ash and slag (and high water content in coal) impede downward burning. Burns appear to be symmetrical in plan view, but not in elevation view. Injection and linking at the bottom of the seam can improve performance. Heat losses begin, and heating value declines, when burns reach the roof rock. In general, heating value and chemistry appear to be insensitive to operational parameters but are sensitive to process-well geometry and overburden. Underground coal gasification produces hot (up to 600 C) gas containing particulate, tar, and steam which must be dealt with. Most UCG process experience was in flat or gently dipping seams using the linked vertical well method. The steeply dipping bed geometry is favorable for UCG. The controlled retracting injection point method may alleviate many underground coal gasification problems. DOE

N83-24606# Oak Ridge National Lab., Tenn. Chemical Technology Div.

EVALUATION OF COKING BEHAVIOR IN COAL-LIQUEFACTION-PROCESS EQUIPMENT

K. H. LIN, G. C. FRAZIER (Tennessee Univ., Knoxville), and R. E. EDWARDS, JR. (Tennessee Univ., Knoxville) 1982 8 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8-13 Aug. 1982 (Contract W-7405-ENG-26) (DE82-020831; CONF-820814) Avail: NTIS HC A02/MF A01

Formation/deposition of coke-like solids in process equipment represents one of the crucial problems in coal liquefaction processes, yet the causes for such behavior are not well understood. The results of the state of the art review in understanding coking behavior, with an emphasis on possible application to coking in coal liquids is presented. Preliminary dimensional correlations that resulted from a comprehensive analysis of the coking data from preheater test runs in the coal liquefaction pilot plant are also presented. The correlations indicate process conditions and certain coal characteristics that may lead to incipient coke formation. Further studies and additional data are required to refine these correlations. DOE

N83-24608# SRI International Corp., Menlo Park, Calif **EXPLORATORY STUDY OF COAL-CONVERSION CHEMISTRY Quarterly Report, 19 Feb. - 18 May 1982**

D. S. ROSS, D. F. MCMILLEN, W. C. OGIER, R. H. FLEMING, and G. P. HUM Jun. 1982 50 p refs (Contract DE-AC22-81PC-40785) (DE82-020736; DOE/PC-40785/4, QR-4) Avail: NTIS HC A03/MF A01

SRI is conducting a program on the chemistry of the conversion of coal to liquid fuels: Task A deals with mechanisms of donor solvent liquefaction; Task B is a study of the conversion of coal and model compounds in the CO/H₂O system. In Task A, determination of the products, rates and mechanisms of central bond scission of diphenyl ether and 1,2-dinaphthylmethane in tetralin, 9,10-dihydroanthracene, and 9,10-dihydrophenanthrene allows us to determine the predominant mechanism of hydrogen transfer to these substrates. Diphenyl ether decomposes in the above three solvents by a radical addition-elimination mechanism, with defined first-order rate constants of approx 1 x 10 to the minus 7th power, 2 x 10 to the minus 6th power, and 2 x 10 to the minus 7th power S(-1), respectively. The relative reactivity of the two substrates, the relative reactivity in the three solvents, and the positional preference for hydrogen transfer provide compelling evidence for the previously unreported single-step transfer of hydrogen from a radical to a closed-shell pi-system. Efforts in Task B were concentrated on the conversion of anisole in D₂O and in tetralin at 400 C. DOE

N83-24610# Exxon Nuclear Idaho Co., Inc., Idaho Falls Idaho Chemical Processing Plant.

AUTOIGNITION OF KEROSENE IN FLUIDIZED-BED PILOT-PLANT CALCINERS

R. J. RAMER Jan 1982 75 p refs (Contract DE-AC07-79ID-01675) (DE82-008764, ENICO-1106) Avail: NTIS HC A04/MF A01

Studies were conducted to determine minimum autoignition temperatures of kerosene in 15-cm and 30-cm diameter in-bed combustion pilot plant fluidized-bed calciners. Limits of flammability were calculated to ensure safe operating conditions while testing various bed materials. Recommendations for pilot-plant and New Waste Calcining Facility operation are made based on the pilot-plant studies. DOE

N83-24618# Midwest Research Inst., Kansas City, Mo. Energy and Materials Science Dept.

FUTURE AVAILABILITY OF CATALYST METALS FOR SYNFUEL PROCESSES Final Report

S. MORI and A. D. MCELROY 1982 77 p refs (Contract DE-AC01-81ER-30015; MRI PROJ 7265-G) (DE82-015628; DOE/ER-30015/T1) Avail NTIS HC A05/MF A01

The availability of catalyst metals for the manufacture of synthetic fuels from coal, oil shale, and tar sands was investigated. The commercialization of various processes for producing synthetic fuels in terms of their impact on the consumption of catalyst materials was investigated, using a standard 50,000-BPD plant or a 300 million-SCFD substitute natural gas (SNG) plant as a basis for comparison. These results were then scaled up to national replacement levels of 6 million BPD synthetic crude oil and 10 billion SCFD of SNG. These figures would correspond to a 40% replacement of petroleum and a 20% replacement of natural gas at current consumption rates. The major catalyst metals required for a synthetic fuels industry would include cobalt, molybdenum, nickel, iron, chromium, and tungsten, with minor amounts of the platinum and rare earth group metals. Certain options were found to be at least technically feasible; molybdenum alone can be used to catalyze the direct liquefaction of coal, and an alloy of iron and titanium can be used as a methanation catalyst to replace nickel. DOE

N83-24622# SRI International Corp., Menlo Park, Calif.
IDENTIFICATION AND CLEAVAGE OF BREAKABLE SINGLE BONDS BY SELECTIVE OXIDATION, REDUCTION AND HYDROLYSIS Quarterly Report, 1 Oct. - 31 Dec. 1981
 A. S. HIRSCHON, J. ZEVELY, and F. R. MAYO 26 Feb. 1982
 22 p
 (Contract DE-AC22-78ET-11423)
 (DE82-011870; DOE/ET-11423/T3; QR-13) Avail: NTIS HC A02/MF A01

Bituminous coal is assumed to consist mostly of aggregates of condensed aromatic and aliphatic rings which are connected and made soluble by crosslinks containing single bonds. The structure of bituminous coal with emphasis on the crosslinks and breakable single bonds was determined. During this past quarter the following studies were conducted on Illinois No. 6 coal: extraction with benzylamine (BnH₂), ethanolamine, ethylenediamine (EDA), pyridine; saponification of some toluene insoluble, pyridine soluble (TIPS) fraction; cleavages by amines; oxidation with aqueous NaOCl of butylated and methylated pyridine extracted coal; decarboxylation on black acids. The investigations dealt with two kinds of connecting links in coal, which are designated as ester and ether groups. The ester groups are cleaved by strongly basic amines (to give amides) at 25 C and by alcoholic KOH at 100 C (to give salts and alcohols or phenols). DOE

N83-24623# Ames Lab., Iowa.
DEVELOPMENT OF AN EFFICIENT COAL-DESULFURIZATION PROCESS: OXY-ALKALINOLYSIS
 T. AIDA, C. G. VENIER, and T. G. SQUIRES (Advanced Fuel Research) Sep. 1982 7 p refs Presented at the Am Chem Soc. Symp. on Coal Liquefaction, Kansas City, Mo., 1 Sep. 1982 (Contract W-7405-ENG-82)
 (DE82-016384; IS-M-382; CONF-820909-5) Avail: NTIS HC A02/MF A01

The concept of first oxidizing the sulfur from coal and then exploiting the enhanced chemical reactivity of functional groups such as sulfoxides, sulfones, and sulfonic and sulfinic acids to design a coal desulfurization process is discussed. This approach is based on the facile oxidation of organic sulfur by electrophilic reagents and the cleavage of C-SO_x bonds by molten alkali. The process is best described as oxy-alkalinolysis. Conclusions are that this desulfurization method was developed on the basis of the demonstrated chemistry of organic sulfur functionalities; organic sulfur in coal can be activated with Cl₂ for removal by molten KOH, probably through electrophilic oxidation; oxy-alkalinolysis is a method for deep cleaning of coal, i.e., efficient removal of organic sulfur, under mild conditions, and residual chlorine can be removed from coal with molten KOH. DOE

N83-24624# Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEVELOPMENT AND APPLICATION OF ANALYTICAL TECHNIQUES TO CHEMISTRY OF DONOR SOLVENT LIQUEFACTION Final Report, 1 Jan. 1980 - 31 Dec. 1981
 H. C. DORN and L. T. TAYLOR 1982 82 p refs
 (Contract DE-AC22-80PC-30041)
 (DE82-012255; DOE/PC-30041/T8) Avail: NTIS HC A05/MF A01

Analytical techniques for the characterization of coal conversion products were developed and applied. Solvent refined coal and process solvents derived therefrom served as the coal derived material for the duration of the study. The investigation was focused primarily in the areas of inductively coupled plasma atomic emission spectrometry (ICP-AES) and nuclear magnetic resonance spectroscopy (NMR). Highlights of the twenty-four month study are: trace metal analyses of ashed SRC fractions via ICP-AES; ICP-AES as a multielement detector in gel permeation chromatography; GPC-ICP-AES applied to SRC fractions; ICP-AES detection in normal phase chromatography; LC-1H NMR applied to a high field NMR system; LC-1H NMR analysis of coal recycle solvents; fluorine reagents examined for speciating heteroatoms in SRC; application of p-fluorobenzoyl chloride reagent to model

samples; and application of the p-fluorobenzoyl chloride reagent to SRC fractions. DOE

N83-24625# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
CATALYTIC HYDRODENITROGENATION OF QUINOLINE IN A TRICKLE-BED REACTOR. COMPARISON WITH VAPOR-PHASE REACTION Quarterly Report, 1 May - 31 Jul. 1982
 C. N. SATTERFIELD and S. H. YANG 1982 113 p refs
 (Contract DE-AC22-80PC-30075)
 (DE82-019424; DOE/PC-30075/10) Avail: NTIS HC A06/MF A01

Studies at 350, 375, and 390 C, and 6.9 MPa showed that the presence of H₂S (generated in situ from CS₂) in the overall reaction network somewhat inhibits hydrogenation and dehydrogenation reactions but markedly accelerates hydrogenolysis reactions, for a net increase in the overall rate of hydrodenitrogenation (HDN). These effects are similar to those observed previously in vapor-phase reactions. H₂S has little effect on the activation energies for the hydrogenation and dehydrogenation reactions, but significantly reduces those for the hydrogenolysis reactions. Certain plugging problems encountered upon reacting 5,6,7,8 tetrahydroquinoline are attributed to formation of a trimer imine as an intermediate. DOE

N83-24626# United Technologies Corp., South Windsor, Conn.
EFFECT OF GASIFIER-FEED-RATE VARIATIONS ON COAL-GAS-COMBUSTION CHARACTERISTICS Final Report
 T. J. GILMARTIN, F. S. KEMP, J. P. GRANT, and G. N. RICHTER May 1982 112 p refs
 (Contract EPRI PROJ 985-1)
 (DE82-905367, EPRI-AP-2216) Avail: NTIS HC A06/MF A01

Combined-cycle industrial gas turbines fired on coal-derived gaseous fuels will play an important role in future electric power generation. Conventional, diffusion-flame type, gas turbine combustors can successfully burn lower heating value (LHV) gases with only minor modifications. However, the peak flame temperatures which result from the combustion of medium heating value (MHV) gases in these combustors are comparable to natural gas, resulting in undesirably high concentrations of NO/sub x/. Combustors incorporating new design schemes optimized for use with MHV gases have been tested and were found capable of meeting Environmental Protection Agency (EPA) NO/sub x/ requirements without water injection. The purpose of this program was to confirm these early data by operating previously evaluated combustors during an extended series of gasifier test programs. DOE

N83-24627# International Coal Refining Co., Birmingham, Ala.
SRC-1 COAL-LIQUEFACTION DEMONSTRATION PLANT PROJECT BASELINE ASSESSMENT REPORT
 Apr. 1982 547 p
 (Contract DE-AC05-78OR-03054)
 (DE82-013863; DOE/OR-03054/T11) Avail: NTIS HC A23/MF A01

A comprehensive project baseline for the SRC-1 demonstration project is presented. The baseline provides the information necessary for Congressional decisions relating to the extent of government participation in, and support of, the project in the detailed design, construction and operation phases. The project baseline is a documented reference position for controlling work and cost. It is made up of a documented design configuration, a documented estimate to perform the work, and a detailed schedule of the activities required to complete the project. All elements of the project baseline were developed within the constraints of the project criteria. The Project Baseline was reviewed for reasonableness, completeness, quality, and consistency. DOE

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N83-24675# United Technologies Corp., South Windsor, Conn Power Systems Div.

PARAMETER MONITORING FOR CORROSION CONTROL OF UTILITY GAS TURBINES Final Report

M. KRASIJ, B. M. BARNUM, and F. S. KEMP Dec. 1982 117 p refs

(Contract EPRI PROJ. 643-1)

(DE83-900991, EPRI-AP-2737) Avail: NTIS HC A06/MF A01

Hot corrosion of turbine airfoil materials which is one of the main factors limiting the durability in industrial gas turbine engines was examined. It is caused primarily by the reaction of deposited alkali sulfate with the turbine airfoil materials. It was confirmed that: (1) a corrosion control system operating in a field environment would reliably measure the accumulation of corrosants ingested in an engine; and (2) removal of accumulated corrosants would effectively inhibit hot corrosion. It is shown that the turbine vanes in the test engine, which was water washed when the corrosion control system determined that the total ingested sodium concentration exceeded a critical limit, had fewer deposits and were significantly less corroded than those installed in the control engine. It is shown that the corrosion control system is effective and performed satisfactorily in a field environment. DOE

N83-24711*# Jet Propulsion Lab., California Inst. of Tech., Pasadena

INFLUENCE OF LIQUID WATER AND WATER VAPOR ON ANTIMISTING KEROSENE (AMK) Final Report, Aug. 1980 - Sep. 1981

A. H. YAVROUIAN, M. SAROLOUKI, and V. SAROHIA Feb. 1983 79 p refs

(Contract DTFA03-80-A-00215)

(NASA-CR-170280; JPL-Pub-82-80; NAS 1 26-170280) Avail: NTIS HC A05/MF A01

Experiments have been performed to evaluate the compatibility of liquid water and water vapor with antimisting kerosenes (AMK) containing polymer additive FM-9 developed by Imperial Chemical Industries. This effort consists of the determination of water solubility in AMK, influence of water on restoration (degradation) of AMK, and effect of water on standard AMK quality control methods. The principal conclusions of this investigation are: (1) the uptake of water in AMK critically depends upon the degree of agitation and can be as high as 1300 ppm at 20 C, (2) more than 250 to 300 ppm of water in AMK causes an insoluble second phase to form. The amount of this second phase depends on fuel temperature, agitation, degree of restoration (degradation) and the water content of the fuel, (3) laboratory scale experiments indicate precipitate formation when water vapor comes in contact with cold fuel surfaces at a much lower level of water (125 to 150 ppm), (4) precipitate formation is very pronounced in these experiments where humid air is percolated through a cold fuel (-20 C), (5) laboratory tests further indicate that water droplet settling time is markedly reduced in AMK as compared to jet A, (6) limited low temperature testing down to -30 C under laboratory conditions indicates the formation of stable, transparent gels.

S.L.

N83-24716# Reinke (Ralph G.), Wausau, Wis.

DISTILLING ALCOHOL WITH WASTE AUTOMOBILE HEAT Final Report

R. G. REINKE 30 Jun. 1982 11 p

(Contract DE-FG02-81AF-92017)

(DE82-018727; DOE/AF-92017/T2) Avail: NTIS HC A02/MF A01

A device that utilizes the waste heat of an automobile for the production of alcohol fuel was developed. Waste heat is obtained via heat exchanger on the exhaust pipe and one on the radiator fluid line. Operation is by automatic control. Instillation of the unit is found to be too difficult. Administrative details regarding permits to distill, obtaining raw stock, and tax rules are discussed. DOE

N83-24717# Department of Energy, Washington, D. C.

REPORT TO THE CONGRESS: STRATEGIC ALCOHOL FUEL RESERVE

31 Dec 1982 121 p

(DE83-005454, DOE/EP-0079) Avail: NTIS HC A06/MF A01

The feasibility of developing a Strategic Alcohol Fuel Reserve (SAFURE) is examined in this report. The analysis compares each of three different ethanol storage program options to that portion of the currently-planned Strategic Petroleum Reserve (SPR) which could be replaced by a particular SAFURE program. These options are: Ethanol Spare Production Capacity Utilization using essentially uneconomical, existing production capacity; Market Diversion through government purchases of ethanol for SAFURE storage, and Dedicated Plants using federal contracts to procure the entire output of five new plants. Based on this most recent analysis and other information currently available, it was concluded that the costs of acquiring, storing and managing an alcohol fuel reserve are substantially higher than the costs of the current SPR program. The net economic and security benefits of the current SPR program are also higher, and the budget costs of the SPR program are lower. DOE

N83-24719# Energy and Minerals Research Co., Exton, Pa.

COAL/OIL THIXOGEL FUELS FOR DIESELS

J. R. ZATKO, E. N. TWESME, W. B. TARPLEY, JR., and R. N. WARES (Bartlesville Energy Technology Center) Sep 1982 35 p

(Contract DE-AC19-81BC-10430)

(DE83-000398, DOE/BC-10430/1) Avail: NTIS HC A03/MF A01

A thixogel of particulate coal in oil, water or methanol was developed as an alternate fuel for diesel engines. Diesel use requires ultrafine coal particles which are virtually ash free and relatively sulfur free. Ultrasonic grinding can efficiently produce ultrafine coal. The principal task remaining is to complete the ash removal process economically. Of the various physical cleaning methods investigated, comminution followed by selective agglomeration was most effective, reducing ash/sulfur contaminants up to 60%. By optimizing the laboratory methods of agglomeration, including the use of ultrasonic energy for selective coalescence and/or flow promotion, these techniques have the potential for virtually complete, economically feasible high volume cleaning. It is also recommended that coals of differing compositions be evaluated in the thixotropic gel system, to determine if the differences indicate preferential coal type use. DOE

N83-24721# Missouri Univ., Rolla. Dept. of Mechanical Engineering.

ALCOHOL/PETROLEUM SYSTEMS AS FUELS FOR DIESEL ENGINES Final Report

R. T. JOHNSON, S. E. FRIBERG, and J. O. STOFFER Jun 1982 244 p refs

(Contract DE-AC02-79CS-50026)

(DE82-020752, DOE/CS-50026/1) Avail: NTIS HC A11/MF A01

Alcohol/petroleum systems containing methanol, ethanol, water, and diesel fuels were formulated and evaluated. The purpose of the work was to develop and evaluate stabilized single phase fuel systems for diesel engines. These systems contained alcohol, contamination water, and a non-ionic chemical stabilizer in a base fuel. Preliminary formulation studies of some ionic stabilizer systems were also made. Fuel formulation work led to two fuel systems using hexanol as a stabilizer: one with azeotropic ethanol as the alcohol-water fuel portion and the second using methanol with 2% by weight water added as the alcohol-water component. Fuel property and engine tests show that the behavior of these systems is similar for three different base fuels of aromatic content from 20 to 40%. For commercial engines, the stabilized fuels demonstrated little change in energy efficiency or gaseous emissions over the base fuels. However, there were reductions in smoke and particulates, especially for the direct injection engine tested. DOE

N83-24724# Oak Ridge National Lab., Tenn Chemical Technology Div.

TESTING AND VALIDATION OF THE PURDUE PHYSICAL PROPERTIES PACKAGE (PPROP) CODE

R. SALMON, W. C. ULRICH, P. J. JOHNSON, and J. A. GARDNER Feb. 1982 82 p refs

(Contract W-7405-ENG-26)

(DE82-007727, ORNL/TM-7374) Avail. NTIS HC A05/MF A01

The Purdue Physical Properties Package (PPROP) computer program was designed for the estimation of physical properties of process streams encountered in the modeling of coal conversion processes. A validation study made to determine the reliability, accuracy, and usefulness of PPROP is discussed. Computer runs were made to test the operability and range of routines and functions for estimating properties of pure components and mixtures. Results of the test runs were compared with literature to determine the accuracy of PPROP calculations for vapor-liquid equilibrium K values (vapor pressures, vapor fugacities, liquid activity coefficients, and liquid reference fugacities); isothermal and adiabatic flash calculations; enthalpies of liquids and vapors (including water and steam); pseudocomponent (mixtures defined by boiling range) properties based on American Petroleum Institute gravities, mean average boiling points, and molecular weights; gaseous volumes and densities; and sample process flowsheet problems. PPROP results agreed fairly well with published data.

DOE

N83-24725# Southwest Research Inst., San Antonio, Tex Div of Engines, Fuels and Lubricants.

COTTONSEED OIL AS A DIESEL-ENGINE FUEL, PART 1 Final Report

H. E. STAPH and J. J. STAUDT 31 Jul. 1982 97 p refs 2 Vol.

(DE83-900881, TENRAC/EDF-070-PT-1) Avail: NTIS HC A05/MF A01

If diesel fuel becomes unavailable for any reason, can diesel powered farm equipment function on alternate fuels from energy crops that are available on the farm. This project sought to gain some insight into this question through the use of once refined cottonseed oil as fuel in a typical unmodified agricultural diesel engine. The engine used for test was a Model DT-436B 6 cylinder, inline, direct injection, turbocharged engine of approximately 175 brake horsepower at 2500 rpm. The engine was run on a stationary stand using blends of reference diesel fuel (DF-2), once refined cottonseed oil (CSO), and transesterified cottonseed oil (ESCO). The latter is cottonseed oil which was processed to give a methyl ester instead of a glyceride. The volume percent blends of fuels used in the tests ranged from 100% DF-2, to 20/80 DF-2/CSO, 50/50 DF-2/ESCO, 50/50 CSO/ESCO, and 100% ESCO. The test procedures and results are presented. The results suggest that ESCO would probably be a satisfactory substitute for diesel fuel. ESCO presently costs four to five times as much as commercial diesel fuels.

DOE

N83-24726# Southwest Research Inst., San Antonio, Tex. Div. of Engines, Fuels and Lubricants.

COTTONSEED OIL AS A DIESEL-ENGINE FUEL. PART 2: APPENDICES Final Report

H. E. STAPH and J. J. STAUDT 31 Jul. 1982 436 p 2 Vol.

(DE83-900880; TENRAC/EDF-070-PT-2) Avail: NTIS HC A19/MF A01

The original data and the methods used to reduce the data obtained in performance tests on diesel engines fueled by diesel fuel, cottonseed oil, and mixtures of these fuels is presented. The description, data, and photographs relating to the 12 power curve tests are included. Results of a durability evaluation are also included.

DOE

N83-24739# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Synthetic Fuels Facilities Safety.

SAFETY ISSUES RELATED TO SYNTHETIC-FUELS FACILITIES

1982 329 p refs

(Contract DE-AC01-81EV-10659)

(DE82-017671; DOE/EV-10659/T1) Avail. NTIS HC A15/MF A01

The design, siting, construction, operation, and decommissioning of coal gasification, coal liquefaction, and oil shale facilities could present safety risks both to synfuels workers and to the environmental system unless careful controls are exercised. Many of these hazards are expected to be similar to those associated with conventional mining, mineral processing, coking operations, and refining of petroleum. However, because of the chemical and physical properties of coal and shale and their products, the types of technologies to be employed, and the scales of their operations, it has been suggested that unconventional hazards may occur. Issues which summarize the deliberations and work of the Committee on Synthetic Fuels Facilities Safety in evaluating the various technologies and their potentials for unconventional safety hazards are described in Chapters 2 and 3 of the report.

DOE

N83-24787# Sandia Labs., Albuquerque, N. Mex. Div. 1116.

VALIDATION DIAGNOSTICS FOR DEFECTIVE THERMOCOUPLE CIRCUITS

R. P. REED 1982 9 p refs Presented at the 6th Symp. on Temp., Washington, 14-18 Mar. 1982

(Contract DE-AC04-76DP-00789)

(DE82-012778; SAND-82-1518C; CONF-820306-9) Avail. NTIS HC A02/MF A01

Thermocouples, properly used under favorable conditions, can measure temperature with an accepted tolerance. However, when improperly applied or exposed to hostile mechanical, chemical, thermal, or radiation environments, they often fail without the error being evident in the temperature record. Conversely, features that appear to be unreasonable in temperature records can be authentic. When hidden failure occurs during measurement, deliberate recording of supplementary information is necessary to distinguish valid from faulty data. Loop resistance change, circuit isolation, isolated noise potential, and other measures can reveal symptoms of developing defects. Monitored continually along with temperature, they can reveal the occurrence, location, and natures of damage incurred during measurement. Special multiterminal branched thermocouple circuits and combinatorial multiplex switching allow detection of dc measurement noise and decalibration. Symptoms of insidious failure, often consequential, are illustrated by examples from field experience in measuring temperature of a propagating retorting front in underground coal gasification.

DOE

N93-24921# Geological Survey, Washington, D. C.

GEOLOGICAL STUDIES OF THE COST NOS. G-1 AND G-2 WELLS, UNITED STATES NORTH ATLANTIC OUTER CONTINENTAL SHELF

P. A. SCHOLLE, ed. and C. R. WENKAM, ed. 1982 202 p refs

(USGS-CIRC-861) Avail: NTIS HC A09/MF A01

Core sampling and multichannel seismic reflection investigations of the Georges Bank basin are reported. Maps, charts, and graphs summarize results of studies of the lithology, stratigraphy, paleoenvironments, and deposition cycles. Organic geochemical analysis, calculation of basin subsidence, and geomagnetic and magnetic anomaly locations are included.

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N83-24922# Geological Survey, Washington, D. C.
GEOLOGICAL STUDIES OF THE COST NOS. G-1 AND G-2 WELLS, UNITED STATES NORTH ATLANTIC OUTER CONTINENTAL SHELF: INTRODUCTION
P. A. SCHOLLE, ed. and C. R. WENKAM, ed. *In its* Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental Shelf p 1-3 1982
Avail: NTIS HC A09/MF A01

Data from geophysical logs, and examination of conventional cores, well-cuttings, and sidewall cores show that below 10,000 ft, the strata in both wells have moderate porosities and low to moderate permeabilities and are thus considered adequate to poor reservoir rocks. Measurements of vitrinite reflectance, color alteration of visible organic matter, and various geochemical properties suggest that the Tertiary and Cretaceous strata of COST G-1 and G-2 wells are not prospective for oil and gas. The Jurassic rocks at the G-1 site do contain small amounts of thermally mature gas-prone kerogens. At G-2, these Jurassic rocks are also gas-prone and are slightly richer in organic carbon and total extractable hydrocarbons the G-1 rocks, but both sites have only poor to fair oil and gas source-rock potential. A.R.H.

N83-24927# Geological Survey, Washington, D. C.
SIGNIFICANCE OF THE MESOZOIC CARBONATE BANK-REEF SEQUENCE FOR THE PETROLEUM GEOLOGY OF THE GEORGES BANK BASIN
R. E. MATTICK *In its* Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental Shelf p 93-104 1982
Avail: NTIS HC A09/MF A01

The development of the continental shelf margin during Jurassic time is analyzed and an effort is made to show the relationship between carbonate facies, which may or may not be significantly porous, and basinal facies, which may contain large amounts of marine-derived organic carbon. Areas in which these facies are in proximity may prove to be areas where significant amounts of petroleum have accumulated in stratigraphic traps. A.R.H.

N83-24928# Geological Survey, Washington, D. C.
ORGANIC GEOCHEMISTRY OF THE GEORGES BANK BASIN COST NOS. G-1 AND G-2 WELLS
R. E. MILLER, H. E. LERCH, G. E. CLAYPOOL, M. A. SMITH, D. K. OWINGS, D. T. LIGON, and S. B. EISNER *In its* Geol. Studies of the COST Nos. G-1 and G-2 Wells, U.S. North Atlantic Outer Continental Shelf p 105-142 1982
Avail: NTIS HC A09/MF A01

The source-rock characteristics of the stratigraphic intervals that may be considered prospects for the generation of oil or natural gas in the COST Nos. G-1 and G-2 wells from the Georges Bank basin are compared. The depth of burial required for the onset of thermal maturation processes is assessed and the geochemical effects that mud additives may have on the source-rock interpretations are evaluated. A.R.H.

N83-24933# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
NUCLEAR WASTE ISOLATION, GEOPHYSICS AND RESERVOIR ENGINEERING, GEOSCIENCES Annual Report, 1981
Sep. 1982 192 p refs
(Contract DE-AC03-76SF-00098)
(DE83-004044; LBL-13600) Avail: NTIS HC A09/MF A01

Separate abstracts were prepared for the 59 papers of the 1981 annual report of the Earth Science Division at Lawrence Berkeley Laboratory. The general topics covered included nuclear waste isolation, geophysics and reservoir engineering, and geosciences.

N83-24959# California Univ., Berkeley. Lawrence Berkeley Lab.
AN INFERRED CONDUCTIVITY DISTRIBUTION IN THE VICINITY OF MOUNT HOOD, OREGON, BASED ON THE INTERPRETATION OF MAGNETOTELLURIC AND TELLURIC DATA
E. C. MOZLEY and N. E. GOLDSTEIN *In* Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 86-88 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

Magnetotelluric and telluric measurements were acquired in the vicinity of Mount Hood, Oregon, to evaluate the geothermal potential of this stratovolcano located in the High Cascade Range of northern Oregon. The area is characterized by rugged topography ranging from deeply eroded valleys surrounding the volcano, with elevations as low as 2000 ft, to the volcanic peak with a elevation of 11,235 ft. Four stations obtain simultaneously a five component magnetotelluric measurement supplemented by two remote telluric vector measurements and one remote two component magnetic measurement. The data are processed by the auto power and cross spectral estimates obtained through fast Fourier transform algorithm DOE

N83-24960# California Univ., Berkeley. Lawrence Berkeley Lab.
IN-FIELD PROCESSING AND MAGNETOTELLURICS WITH THE EM-60 ELECTROMAGNETIC SYSTEM
M. WILT, N. E. GOLDSTEIN, J. R. HAUGHT, V. LABSON, and H. F. MORRISON *In* Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 88-90 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

The EM-60 electromagnetic system for use in intermediate depth geothermal exploration was investigated. This system is used for geothermal exploration and crustal studies and is proven to be effective even in areas of complex geology or rugged local terrain. The EM-60 system allows for infield data processing and on site calculation of apparent resistivity. The modified system allows for the possibility of simultaneous measurements of controlling source (dipole) electromagnetic and magnetotelluric (MT) soundings. DOE

N83-24961# California Univ., Berkeley. Lawrence Berkeley Lab.
DEEP ELECTROMAGNETIC SOUNDING IN THE BASIN AND RANGE PROVINCE
M. WILT, N. E. GOLDSTEIN, J. R. HAUGHT, and H. F. MORRISON *In* Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 90-91 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

A deep electromagnetic (EM) sounding survey was undertaken in the northern Basin and Range Province. The purposes were: (1) to confirm the presence of deep conductive bodies first detected with a magnetotelluric measurements; (2) to investigate the geometry of these bodies; and (3) to test the source EM system (EM-60) as modified to perform deep sounding work. It is found that the deeply buried conductors may have important tectonic implications; if they consist of partially molten rock, they could be the heat source of the numerous hot springs and geothermal systems in northern Nevada. DOE

N83-24962# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMPLE ONE-DIMENSIONAL INVERSIONS OF MAGNETOTELLURIC DATA
W. M. GOUBAU *In* Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 92-95 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

The exact solution to the one dimensional inverse problem in magnetotellurics was first derived by Weidelt. Often it is much more desirable to find an approximate inverse that can be computed

rapidly. Bostick's algorithm is concise enough that it can be evaluated with a pocket calculator, and in many cases it yields an inverse that reflects all of the essential features of the true inverse. Alternative inversion schemes that are derived from Maxwell's equations are presented. DOE

N83-24964# California Univ., Berkeley. Lawrence Berkeley Lab.

ADVANCES IN TRANSIENT WELL-TESTING METHODOLOGY

C. W. MILLER, S. M. BENSON, and G. S. BODVARSSON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 99-102 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

A major problem in determining the transmissivity and storativity of a geothermal reservoir is that in most cases the flow in the reservoir is two-phase. Conventional well-test methods are primarily applicable to isothermal, single-phase reservoirs. The effects of two-phase well-bore flow on pressure transient tests were investigated and appropriate testing and analysis procedures were determined. Analysis methods for injection tests data in a fractured two-phase reservoir were also studied. DOE

N83-24965# California Univ., Berkeley. Lawrence Berkeley Lab.

LOW- TO MODERATE-TEMPERATURE HYDROTHERMAL RESERVOIR ENGINEERING RESEARCH

S. M. BENSON, R. SOLBAU, and G. S. BODVARSSON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 102-104 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

A computational model for thin fault-charged hydrothermal reservoirs, well-testing instrumentation, case studies of low- to moderate-temperature reservoirs are discussed. DOE

N83-24966# California Univ., Berkeley. Lawrence Berkeley Lab.

EVALUATION OF THE HYDROTHERMAL POTENTIAL OF THE ASHDOD AREA, ISRAEL

S. M. BENSON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 105-107 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

A project to evaluate the hydrothermal potential in and around Ashdod, Israel is discussed. The US Agency for International Development (AID) is evaluating the hydrothermal potential of this area because a sea water desalination plant being constructed in Ashdod will have large requirements for a low-grade heat source. The objective of this evaluation is to determine if the hydrothermal resource at Ashdod is of suitable temperature, brine chemistry, size, and productivity to economically replace the existing heat source for the plant. It is estimated that approximately 2100 m³/hr of 95 C brine will be required to replace the existing heat source. DOE

N83-24967# California Univ., Berkeley. Lawrence Berkeley Lab.

THE BACA DEMONSTRATION PROJECT

G. S. BODVARSSON, M. WILT, J. DELANY, and C. F. TSANG /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 108-110 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

The Baca geothermal field is located in the Valles Caldera, New Mexico, approximately 55 miles north of Albuquerque. The field is being developed for 50 MWe power production. To date, 24 wells have been drilled in the Redondo Creek area in the western part of the caldera. This year's activities and the present status of the Baca project are described. DOE

N83-24968# California Univ., Berkeley. Lawrence Berkeley Lab.

INJECTION OF COLD WATER INTO GEOTHERMAL RESERVOIRS

G. S. BODVARSSON, C. F. TSANG, K. PRUESS, and M. J. OSULLIVAN /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 110-113 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

Reinjection of geothermal wastewater is gradually becoming a preferred means of waste disposal. The increasing interest in reinjection undoubtedly results from growing environmental concerns regarding toxic minerals (e.g., boron, arsenic) present in geothermal wastewater. The advancement of the thermal front during injection into a fractured reservoir system is discussed. The system under consideration consists of equally spaced horizontal fractures intersecting an injection well. Analytical and numerical studies were designed to address the important question of how fractures affect the movement of the thermal front during injection. DOE

N83-24969# California Univ., Berkeley. Lawrence Berkeley Lab.

MODELING OF FRACTURE RESERVOIRS

K. PRUESS, T. N. NARASIMHAN, and G. S. BODVARSSON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 113-115 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

Most geothermal reservoirs are highly fractured systems. The fractures provide conduits through which fluid (and heat) can flow at rates which are sufficiently large to be of commercial interest. Traditional approaches to geothermal reservoir evaluation and analysis have employed a porous medium approximation, which amounts to assuming instantaneous (thermal and hydrologic) equilibrium between fractures and matrix. A new numerical modeling technique, termed the multiple interacting continua method (MINC), was developed which treats transient fluid and heat flow within the matrix and fractures. DOE

N83-24970# California Univ., Berkeley. Lawrence Berkeley Lab.

GENERIC STUDIES OF GEOTHERMAL RESERVOIR BEHAVIOR

K. PRUESS, G. S. BODVARSSON, M. J. LIPPMANN, and A. H. TRUEDELLE (U.S. Geological Survey) /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 115-118 Sep. 1982 refs

Avail: NTIS HC A09/MF A01

The characteristics and behavior of geothermal reservoirs are often strongly influenced by geologic and hydrologic conditions that are peculiar to a given site. Site-specific detail can render a reservoir description and analysis so complex that it becomes difficult to identify the important physical mechanisms and parameters which govern reservoir behavior. Some important insight into the evolution of geothermal reservoirs under natural or man-made conditions can be gained from a study of schematic, idealized representations of such reservoirs. Generic studies are particularly useful for two-phase geothermal reservoirs with coexisting water and steam. The presence of two phases with different densities and heat contents can give rise to peculiar and sometimes surprising phenomena, which can be conveniently explored by means of computer simulation. Two such simulation studies are summarized. One addresses the problem of natural evolution of geothermal reservoirs over geologic time; the other examines energy recovery and reservoir longevity for different completion depths of production wells. DOE

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N83-24971# California Univ., Berkeley. Lawrence Berkeley Lab.

SUBSIDENCE MODELING OF THE PLEASANT BAYOU GEOTHERMAL GEOPRESSURED REGION

K. P. GOYAL, T. N. NARASIMHAN, and S. P. VONDERHAAR /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 118-121 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

The Pleasant Bayou prospect, a geothermal geopressured area, is located in Brazoria County, Texas. Deltaic sandstones of the Frio Formation, at a depth of about 14,000 ft (4.27 km), are found to have potential for a geothermal geopressured reservoir. Two exploratory wells were drilled by the US Department of Energy (DOE), with a separation of 500 ft. The Pleasant Bayou area is part of a deep sedimentary basin traversed by growth faults. For purposes of subsidence modeling, a circular area with a radius of 5 miles and centered at the DOE wells is considered. DOE

N83-24977# California Univ., Berkeley. Lawrence Berkeley Lab.

OVERVIEW OF THE MEXICAN-AMERICAN COOPERATIVE PROGRAM AT THE CERRO PRIETO GEOTHERMAL FIELD

M. J. LIPPMANN and R. ZELWER /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 133-138 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

The Lawrence Berkeley Laboratory is coordinating the US technical activities being carried out at Cerro Prieto under a five-year agreement between the US Department of Energy and the Comision Federal de Electricidad de Mexico. This agreement, signed in July 1977, is expected to expire in July 1982. Efforts are being made to continue some of the research beyond the formal termination of the agreement. A description of the program, which involves studies of geology, geophysics, hydrodynamics, subsidence, geothermal wells and reservoirs, and aquifers, is discussed. DOE

N83-24978# California Univ., Berkeley. Lawrence Berkeley Lab.

GEOLOGIC MODEL OF THE CERRO PRIETO GEOTHERMAL FIELD

S. E. HALFMAN, J. H. HOWARD, and S. P. VONDERHAAR /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 138-141 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

One of the tasks under the Mexican-American cooperative agreement is the comprehensive geologic study of the Cerro Prieto geothermal field. Using logs from over seventy deep wells as the basic source of information on the subsurface geology, a working model of the Cerro Prieto geothermal field is developed. DOE

N83-24979# California Univ., Berkeley. Lawrence Berkeley Lab.

GEOPHYSICAL MONITORING AT THE CERRO PRIETO GEOTHERMAL FIELD

M. WILT, R. ZELWER, and E. L. MAJER /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 141-144 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

A program of reservoir monitoring at the Cerro Prieto geothermal field using surface geophysical methods with the objective of observing changes resulting from production is described. The three methods used, dipole-dipole resistivity, precision gravity, and passive seismic monitoring, are discussed. DOE

N83-24980# California Univ., Berkeley. Lawrence Berkeley Lab.

RESERVOIR ENGINEERING STUDIES OF THE CERRO PRIETO GEOTHERMAL FIELD

K. P. GOYAL, M. J. LIPPMANN, and C. F. TSANG /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 144-147 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

Reservoir engineering studies of the Cerro Prieto geothermal field began in 1978 under a five-year cooperative agreement between the US Department of Energy and the Comision Federal de Electricidad de Mexico, with the ultimate objective of simulating the reservoir to forecast its production capacity, energy longevity, and recharge capability under various production and injection scenarios. During the fiscal year 1981, attempts were made to collect information on the evolution history of the field since exploitation began; the information is to be used later to validate the reservoir model. To this end, wellhead production data were analyzed for heat and mass flow and also for changes in reservoir pressures, temperatures, and saturations for the period from March 1973 to November 1980. DOE

N83-24981# California Univ., Berkeley. Lawrence Berkeley Lab.

THE BEHAVIOR OF ROCK-FLUID SYSTEMS AT ELEVATED TEMPERATURES AND PRESSURES

W. H. SOMERTON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 151-152 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

Data on the following properties of rock-fluid systems are given: deformation properties, including pore and bulk compressibilities and thermal expansions; P- and S-wave velocities, absolute permeability, electrical resistivity factor; and thermal properties, including conductivity, diffusivity, and specific heats. Work accomplished during the past year in two areas (modeling of pore and bulk compressibilities and thermal expansions, and measurements of electrical resistivity factors at elevated temperatures) is reviewed. DOE

N83-24987# California Univ., Berkeley. Lawrence Berkeley Lab.

ENHANCED RECOVERY OF HEAVY OILS WITH ALKALI

C. J. RADKE and W. H. SOMERTON /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 166-167 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

Many oils, especially those classed as heavy oils, contain natural acids, such as alkyl and aryl carboxylics and porphyrins. In contact with aqueous alkalis, these acidic components can produce surface-active molecules that aid in oil displacement. The objective of this project is to study the fundamental mechanisms of alkali-enhanced oil recovery to permit better process design. Author

N83-24990# California Univ., Berkeley. Lawrence Berkeley Lab.

MINE VENTILATION PLANNING: A CASE STUDY

M. J. MCPHERSON and M. HOOD /in Lawrence Berkeley Lab. Nucl. Waste Isolation, Geophys. and Reservoir Eng., Geosci. p 173-177 Sep. 1982 refs
Avail: NTIS HC A09/MF A01

One of the main objectives of this work program was to investigate the benefits of employing a systems approach to ventilation design in an existing U.S. mine. Sunnyside Mine 3 in Utah has been operating continuously for more than 80 yr. It was selected for the study because its ventilation system was incapable of supplying adequate quantities of air to the working faces. Author

N83-24998*# Pacific Northwest Lab., Richland, Wash.
LANDSAT-4 IMAGE DATA QUALITY ANALYSIS FOR ENERGY RELATED APPLICATIONS Quarterly Report

G. E. WUKELIC, Principal Investigators 11 Apr. 1983 11 p
 Original contains color imagery. Original photography may be purchased from EROS Data Center, Sioux Falls, SD 57198 ERTS

(Contract NASA ORDER S-12402-C)
 (E83-10295; NASA-CR-170326; NAS 1.26.170326, PNL-4723, QR-1) Avail: NTIS HC A02/MF A01 CSCL 05B

No useable LANDSAT 4 TM data were obtained for the Hanford site in the Columbia Plateau region, but TM simulator data for a Virginia Electric Company nuclear power plant was used to test image processing algorithms. Principal component analyses of this data set clearly indicated that thermal plumes in surface waters used for reactor cooling would be discernible. Image processing and analysis programs were successfully testing using the 7 band Arkansas test scene and preliminary analysis of TM data for the Savannah River Plant shows that current interactive, image enhancement, analysis and integration techniques can be effectively used for LANDSAT 4 data. Thermal band data appear adequate for gross estimates of thermal changes occurring near operating nuclear facilities especially in surface water bodies being used for reactor cooling purposes. Additional image processing software was written and tested which provides for more rapid and effective analysis of the 7 band TM data. A R H.

N83-25018# North Dakota Univ., Grand Forks.

DICKINSON GEOTHERMAL STUDY Final Report

G. O. FOSSUM, K. L. HARRIS, D. J. HASSETT, D. V. MATHSEN, and T. C. OWENS Jun. 1982 95 p refs

(Contract DE-AC07-76ID-01570)
 (DE82-016945; EGG-2151) Avail: NTIS HC A05/MF A01

The Inyan Kara Formation provides an abundant source of warm (54 to 71 C) but salty (7400 mg/l combined Na and Cl ions) water for much of southwestern North Dakota. The city of Dickinson, ND, overlies this aquifer at 1676 to 1768 meters. This study investigates the potential of using this hydrothermal resource as an energy source for a district heating system in a new undeveloped addition to Dickinson. In addition, the use of a reverse osmosis system to desalinate the water is considered along with other water treatment processes necessary to allow use of this water in the existing city water supply. The results of the study indicate the economic requirements to make this concept feasible and outline the consideration to carry the project into the design phase. DOE

N83-25019# Michigan Univ., Ann Arbor. Dept. of Geological Sciences

APPRAISAL OF LANDSAT LINEAMENTS AS FAULTS IN WESTERN KENTUCKY Final Report

P. L. JACKSON Dec. 1982 71 p refs

(Contract DE-AC21-81MC-16463)
 (DE83-005412; DOE/MC-16463/1324; REPT-019277-C) Avail: NTIS HC A04/MF A01

Lineaments which resemble those produced by known, mapped geologic faults are found on LANDSAT images of a portion of Western Kentucky. Since fractures and faults are suspected to be necessary for gas production in the eastern gas shales, it would be valuable to evaluate such lineaments as faults. For this purpose surface geophysical measurements were made across the lineaments and also across mapped faults for control. Resistivity, gravity, and radiation measurements showed that the mapped faults produce geophysically measured anomalies, and also gave probable indication of faulting along two LANDSAT lineaments. These economical geophysical measurements are a useful, but not certain, method of evaluating LANDSAT lineaments as faults. DOE

N83-25021# Oak Ridge National Lab., Tenn. Engineering Technology Div.

CHATTANOOGA SHALE: AN ASSESSMENT OF THE RESOURCE AND TECHNOLOGY FOR RECOVERY OF HYDROCARBONS AND MINERALS

I. SPIEWAK, E. S. BOMAR, T. R. BUTZ, J. G. DELENE, J. E. DOBSON, G. K. EDDLEMON, E. C. FOX, C. W. GEHRS, R. N. HELGERSON, R. H. KETELLE et al. Apr. 1982 238 p refs
 (Contract W-7405-ENG-26)

(DE82-012372; ORNL/TM-7920) Avail: NTIS HC A11/MF A01

Chattanooga shale, a large and mineral rich member of the Devonian oil shales of the Eastern United States, is a resource of about 100 billion bbl of oil, 10 million tons of uranium, and significant quantities of other metals including aluminum, molybdenum, cobalt, columbium, and vanadium. Chattanooga shale is not yet ready for commercial exploitation. It is indicated that a large scale combined operation for oil and metals recovery is economically attractive. Some of the principal technical problems that require resolution are: roof stability and water intrusion associated with the underground mining of Chattanooga shale, the need for environmentally acceptable methods for disposal of tremendous quantities of spent shale, and the need for processes that can efficiently recover most of the hydrocarbon and mineral values with minimal loss of expensive processing reagents. DOE

N83-25022# Oak Ridge Gaseous Diffusion Plant, Tenn.

HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR BOISE QUADRANGLE, OREGON; IDAHO

9 Nov 1982 50 p

(Contract DE-AC13-76GJ-01664)

(DE83-004483, GJBX-171-82, K/UR-451) Avail: NTIS HC A03/MF A01

Hydrogeochemical data are compiled for surface water and ground water from the Boise Quadrangle in Oregon and Idaho. DOE

N83-25023# North Dakota Univ., Grand Forks Engineering Experiment Station.

EVALUATION OF HYDROTHERMAL RESOURCES OF NORTH DAKOTA, PHASE 3 Final Technical Report

K. L. HARRIS, F. L. HOWELL, B. L. WARTMAN, and S. B. ANDERSON Aug. 1982 209 p refs

(Contract DE-FC07-79ID-12030)

(DE83-004641; DOE/ID-12030/T3, BULL-82-08-EES-01) Avail: NTIS HC A10/MF A01

The hydrothermal resources of North Dakota were evaluated. This evaluation was based on existing data on file with the North Dakota Geological Survey (NDGS) and other state and federal agencies, and field and laboratory studies conducted. The principal sources of data used during the study were WELLFILE, the computer library of oil and gas well data developed during the Phase 1 study, and WATERCAT, a computer library system of water well data assembled during the Phase 2 study. A field survey of the shallow geothermal gradients present in selected ground water observation holes was conducted. Laboratory determinations of the thermal conductivity of core samples were done to facilitate heat flow calculations on those holes of convenience cased. DOE

N83-25037*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

IGCC PERFORMANCE COMPARISON FOR VARIATIONS IN GASIFIER TYPE AND GAS TURBINE FIRING TEMPERATURE

R. J. STOCHL and J. J. NAINIGER Jan. 1983 40 p refs

(NASA-TM-83310; E-1549; NAS 1.15.83310) Avail: NTIS HC A03/MF A01 CSCL 10B

Performance estimates were made for a series of integrated coal gasification combined cycle (IGCC) power systems using three generic types of coal gasification subsystems. The objectives of this study were (1) to provide a self consistent comparison of IGCC systems using different types of gasifiers and different oxidants and (2) to use this framework of cases to evaluate the

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effect of a gas turbine firing temperature and cooling approach an overall system efficiency. The basic IGCC systems considered included both air and oxygen blown versions of a fluidized bed gasifier, represented by the Westinghouse design, and an entrained bed gasifier, represented by the Texaco design. Also considered were systems using an oxygen blown, fixed bed gasifier, represented by the British Gas Corporation (BGC) slagging gasifier. All of these gasifiers were integrated with a combined cycle using a gas turbine firing temperature of 1700 K (2600 F) and a compressor pressure ratio of 16:1. Steam turbine throttle conditions were chosen to be 16.6 MPa/811 K (2400 psia/1000 F) with a single reheat to 810 K (1000 F). Some of these cases were modified to allow the evaluation of the effect of gas turbine firing temperature. Turbine firing temperatures from state of the art 1365 K (2000 F) to an advanced technology 1920 K (3000 F) were analyzed. A turbine cooling technology that maintains metal temperatures below acceptable limits was assumed for each level of firing temperature. System performance comparisons were made using three advanced turbine cooling technologies for the 1920 K (3000 F) firing temperature. The results indicate that the IGCC using the BGC gasifier had the highest net system efficiency (42.1 percent) of the five gasification cases considered. B.W.

N83-25051# National Academy of Sciences - National Research Council, Washington, D. C.
WORKSHOP REPORT ON BASIC RESEARCH IN ORGANIC GEOCHEMISTRY APPLIED TO NATIONAL ENERGY NEEDS
Jan. 1982 128 p refs Workshop held in St. Petersburg, Fla., 15-17 Dec. 1980
(CONF-801249) Avail: NTIS HC A07/MF A01

The direction and distance of migration of petroleum from the source rocks to reservoir type rocks where petroleum accumulations can come into existence were studied. The biogeochemical and abiotic processes that accompany the formation and breakdown of kerogen and which finally lead to the generation of petroleum, and the depositional model systems which improve the predictive capability of recognizing favorable conditions for hydrocarbon accumulations were also investigated. S.L.

N83-25115# California Univ., Livermore. --Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
Nov. 1982 38 p refs
(Contract W-7405-ENG-48)
(DE83-003802; UCRL-52000-82-11) Avail: NTIS HC A03/MF A01

Large-block experiments in underground coal gasification, the regional seismic test network, and tandem mirror devices are discussed.

N83-25116# California Univ., Livermore. Lawrence Livermore Lab.
LARGE-BLOCK EXPERIMENTS IN UNDERGROUND COAL GASIFICATION
In its Energy and Technol Rev. p 1-13 Nov. 1982 refs
Avail: NTIS HC A03/MF A01

The experiments were conducted in a 7.6 m thick subbituminous coal seam at a relatively shallow depth of 48 m. Author

N83-25119# Arizona Univ., Tucson. Dept. of Chemical Engineering.
POTENTIAL OF UTILIZATION OF GEOTHERMAL ENERGY IN ARIZONA Executive Summary Report
D. H. WHITE and L. A. GOLDSTONE Aug. 1982 61 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004875; DOE/RA-50076/1) Avail: NTIS HC A04/MF A01

Arizona is one of the fastest growing states in the United States. It is in the midst of the movement of the population of the United States from its cold regions to the warm Southwest. Being a hot, arid region, its electrical demand is nearly 50% higher in the peak hot summer months than that of the other 7 months. The major uncertainty of utilizing geothermal energy in Arizona is

that very little exploration and development have occurred to date. The potential for utilizing geothermal energy in Arizona is good based on the fact that there are over 3000 thermal wells in Arizona out of a total of about 30,000 shallow irrigation wells that were examined. There is much young volcanic rock in Arizona. The combination of data from thermal wells, young volcanic rock, water geochemistry and other geological tools, indicate that there is a large geothermal resource throughout the southern half of the state. It is suggested that most of this resource is in the range of 500 to 1500 C, limiting its uses to direct heat utilization rather than for electric power generation DOE

N83-25120# Arizona Univ., Tucson. Dept. of Chemical Engineering.
GEOTHERMAL DEVELOPMENT PLAN: PIMA COUNTY
D. H. WHITE and L. A. GOLDSTONE Aug. 1982 63 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004877; DOE/RA-50076/3) Avail: NTIS HC A04/MF A01

The Pima County Area Development evaluated the county-wide market potential for utilizing geothermal energy. Four potential geothermal resource areas with temperatures less than 1000 C (2120 F) were identified. In addition, one area is identified as having a temperature of 1470 F (2970 F). Geothermal resources are found to occur in Tucson where average population growth rates of two to three percent per year are expected over the next 40 years. Rapid growth in the manufacturing sector and the existence of major copper mines provide opportunities for the direct utilization of geothermal energy. However, available water supplies are identified as a major constraint to projected growth. A regional energy analysis, future predictions for energy consumption, and energy prices are given. Potential geothermal users in Pima County are identified and projections of maximum economic geothermal utilization are given. One hundred fifteen firms in 32 industrial classes have some potential for geothermal use are identified. In addition, 26 agribusiness firms were found in the county. DOE

N83-25122# RANN, Inc., Palo Alto, Calif.
SOME EXPLORATORY CONSIDERATIONS OF SCALE EFFECTS ON THE POTENTIAL PERFORMANCE OF WOOD ENERGY CONVERSION SYSTEMS
A. J. EGGERS, JR., B. A. SMITH, and L. W. TOMBAUGH 24 Jun. 1982 42 p refs
(Contract DE-AC03-80ET-20651)
(DE83-001378; DOE/ET-20651/T2) Avail: NTIS HC A03/MF A01

Scale effects on the potential performance of wood energy conversion systems whose products might compete in many of the same diverse and dispersed markets as comparable products from fossil fuels are explored. The analytical approach is derived from the average total cost formulation of micro-economics which is configured to account for the factors of total cost rate for wood production, transportation, and conversion in systems with a given conversion efficiency and capacity. The exploratory systems analysis includes: systems elements and cost formulation; area production and associated transportation; point production and associated transportation; conversion system capacity effects; conversion plant learning curve effects; subsystem disaggregation, staging, and production rate effects, and conversion plant financing effects. DOE

N83-25133# Catalytic, Inc., Wilsonville, Ala.
OPERATION OF THE WILSONVILLE ADVANCED COAL-LIQUEFACTION R AND D FACILITY, WILSONVILLE, ALABAMA Quarterly Technical Progress Report, Jul. - Sep. 1981
Aug. 1982 188 p
(Contract DE-AC22-76ET-10154)
(DE83-000110; DOE/ET-10154/110) Avail: NTIS HC A09/MF A01

The operating conditions and test results which were obtained at the six ton per day advanced coal liquefaction R & D facility are summarized. The SRC unit operated for approximately 70%

of the period with scheduled shutdowns accounting for more than 20% of the down time Kentucky 9 coal was processed during all runs. Potential process improvements and tests were evaluated in the respective process units. Low severity reactor conditions for two stage liquefaction, and The V103 high pressure separator in the hot separator mode of operation at low severity reaction conditions were evaluated. The correlation between dissolver operating conditions and hydrogen leakage was investigated.

DOE

N83-25139# Sandia Labs., Albuquerque, N. Mex.
THERMOMECHANICAL CAVITY-GROWTH MODELING
R. E. GLASS 1982 18 p refs Presented at the Conf. on Cryptosys., Santa Barbara, Calif., 23 Aug. 1982
(Contract DE-AC04-76DP-00789)
(DE82-020356; SAND-82-0956C; CONF-820852-1) Avail. NTIS HC A02/MF A01

The results of recent field tests, laboratory studies, and modeling efforts in UCG have indicated that the thermal and mechanical properties of coal may be the controlling parameters in determining initial cavity shape. In examining this possibility, laboratory efforts have been directed at determining temperature and bedding plane dependent properties of coal. A thermomechanical model which uses these properties has indicated that the cavity shapes seen at both the Hanna and Hoe Creek test sites result from the temperature dependent properties of the coal such as the coefficients of thermal expansion and the elastic moduli. The model determines stress levels and uses a simple bedding plane dependent stress failure mechanism to determine cavity growth.

DOE

N83-25140# Oak Ridge National Lab., Tenn. Metals and Ceramics Div
ASSESSMENT OF MATERIALS AND COMPONENTS PERFORMANCE IN BI-GAS, WESTINGHOUSE AND COMBUSTION ENGINEERING GASIFICATION PILOT PLANTS
J P HAMMOND and J R. HORTON Aug. 1982 161 p refs
(Contract W-7405-ENG-26)
(DE82-020457; ORNL/TM-8323) Avail. NTIS HC A08/MF A01

The performance of materials and components of three coal gasification pilot plants are assessed. The materials and components problems at the three pilot plants reviewed are generally no longer especially pressing from the viewpoint of successful operation in order to evaluate the individual gasification processes per se. However, for viable commercial processes to emerge, certain components must be developed, and the service lives and/or functionality of others must be improved. In some instances materials performance limitations prevent needed developments. The materials and components problems in the three plants are detailed and needed remedial actions are discussed. Recommendations on generic work required to fill gaps are presented.

DOE

N83-25141# Westinghouse Electric Corp., Madison, Pa. Synthetic Fuels Div.
ADVANCED COAL-GASIFICATION SYSTEM FOR ELECTRIC-POWER GENERATION Final Report, 20 Mar. 1980 - 15 Jan. 1982
E. J. CHELEN, G. B. HALDIPUR, W. J. HAVENER, D. L. KEAJRNS, L. A. SALVADOR, and A. B. TURNER 15 Jun 1982 323 p refs
(Contract DE-AC21-80ET-14752)
(DE82-021338; DOE/ET-14752/28) Avail. NTIS HC A14/MF A01

The development of a pressurized, fluidized bed gasification process is discussed. The objective is to demonstrate the viability of the process for the production of low and intermediate-Btu fuel gas for electric power generation, synthetic natural gas, chemical feedstocks, and industrial fuels. The development and technology activities performed, as well as the PDU test results obtained, are reported.

DOE

N83-25144# Midwest Research Inst., Golden, Colo.
ABLATIVE FAST PYROLYSIS OF BIOMASS IN THE ENTRAINED-FLOW CYCLONIC REACTOR AT SERI
J. DIEBOLD and J. SCAHILL Jun. 1982 40 p refs Presented at the 14th Biomass Thermochem. Conversion Contractor's Meeting, Arlington, Va., 23-25 Jun. 1982
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-019768; SERI/TP-234-1654; CONF-820685-2) Avail. NTIS HC A03/MF A01

Progress with the entrained flow cyclonic reactor at SERI is detailed. Feedstocks successfully used include: wood flour and fairly large sawdust. It is shown that relatively complete vaporization of the biomass is realized and that the yields of tar or gas can be varied over quite a range with trends following first order kinetic concepts.

DOE

N83-25146# BDM Corp., Albuquerque, N. Mex.
GEOHERMAL COMPLETION TECHNOLOGY LIFE-CYCLE COST MODEL (GEOCOM)
A. J. MANSURE and C C. CARSON 1982 4 p refs Presented at the Ann. Geothermal Resources Council Meeting, San Diego, Calif., 11 Oct. 1982
(Contract DE-AC04-77DP-00789)
(DE82-016787; SAND-82-1435C; CONF-821007-2) Avail. NTIS HC A02/MF A01

The GEOCOM is a model which evaluates the cost effectiveness of alternative technologies used in the completion, production, and maintenance of geothermal wells was developed. The model calculates the ratio of life cycle cost to life cycle production or injection and thus is appropriate for evaluating the cost effectiveness of a geothermal well even when the most economically profitable well completion strategies do not result in lowest capital costs. The project to develop the GEOCOM model included the establishment of a data base for studying geothermal completions and preliminary case/sensitivity studies. The code has the data base built into its structure as a default parameters. These parameters include geothermal resource characteristics; costs of geothermal wells, workovers, and equipment; and other data. The GEOCOM model is written in American National Standard Institute (ANSI) FORTRAN 1966 version.

DOE

N83-25154# Energetech Engineering and Research Co., Houston, Tex.
ADVANCED WELLBORE THERMAL SIMULATOR GEOTEMP2 RESEARCH REPORT
R. F. MITCHELL Feb 1982 84 p refs
(Contract DE-AC04-76DP-00789)
(DE82-020050; SAND-82-7003/1) Avail. NTIS HC A05/MF A01

The development of the GEOTEMP2 wellbore thermal simulator is described. The major technical features include a general purpose air and mist drilling simulator and a two-phase steam flow simulator that can model either injection or production.

DOE

N83-25155# Los Alamos Scientific Lab., N. Mex. Earth and Space Sciences Div.
POTENTIAL FOR HOT-DRY-ROCK GEOTHERMAL RESOURCES: EXPERIMENTAL RESULTS
J. C. ROWLEY, G. HEIKEN, H. D. MURPHY, and M. KURIYAGAWA (National Research Inst for Pollution and Resources, Yatabe, Ibaraki, Japan) 1982 18 p refs Presented at the 3rd AAPG Circum-Pacific Energy and Mater Conf., Honolulu, 22-28 Aug. 1982
(Contract W-7405-ENG-36)
(DE82-019534; LA-UR-82-2269; CONF-820834-1) Avail. NTIS HC A02/MF A01

Hot dry rock (HDR) contains insufficient permeability and fluid for natural hydrothermal development, but water pumped in a circulation loop through a HDR reservoir (hydraulically fractured between two drill holes) is being tested and evaluated. The formation of such in situ heat transfer systems, and subsequent testing of the man-made geothermal reservoirs in the Jemez volcanic field, New Mexico have already indicated the technical

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feasibility of the hot dry rock (HDR) geothermal concept. Documented production history and heat-extraction data obtained during the period from 1978 to 1980 have confirmed heat transfer, low water loss, and predictable thermal drawdown models for the HDR systems. During a nine month test of closed-loop heat extraction operations, 15 x 10 to the 6th power kWh of thermal energy were produced. The effective heat-transfer area and volume of the reservoir increased due to secondary fracturing caused by thermal contraction of the reservoir rock, and sustained pressurization. Drilling, fracturing, and testing of a larger, hotter reservoir system is now underway on a HDR geothermal reservoir of commercial size. DOE

N83-25177# Arizona Univ., Tucson Dept of Chemical Engineering
GEOTHERMAL HEATING FOR THE ARIZONA ENVIRONMENTAL RESEARCH LABORATORY GREENHOUSES
D. H. WHITE and L. A. GOLDSTONE Aug 1982 33 p refs
(Contract DE-FC03-80RA-50076)
(DE83-005287, DOE/RA-50076/14) Avail. NTIS HC A03/MF A01

The technical and economic feasibility of installing a retrofit geothermal heating system is analyzed for a greenhouse facility. The facility consists of 10.6 acres of greenhouse area, of which 7.4 acres are currently operational. Natural gas or diesel fuel are presently used for heating. The maximum heating load is estimated to be 28,620,000 Btu/hr. Average annual heating energy consumption was 35,684 million Btu/year for 7.4 acres of greenhouse. The 2500 foot geothermal production wells are required, each capable of producing 1500 gpm of 1300F water. The geothermal water is expected to contain 500 ppm total dissolved solids. The expected first year geothermal energy cost savings are estimated. A simple payback of 9.1 years is calculated. The project as herein presented is marginally economic. However it is clear that an attractive economic case can be made for providing about 50 to 60 percent of the required heating load as a base load using geothermal energy. DOE

N83-25179# Pennsylvania State Univ., University Park Coal Research Section
THE CHARACTERISTICS OF AMERICAN COALS IN RELATION TO THEIR CONVERSION INTO CLEAN-ENERGY FUELS Final Report
W. SPACKMAN, A. DAVIS, P. L. WALKER, H. L. LOVELL, F. J. VASTOLA, P. H. GIVEN, N. H. SUHR, and R. G. JENKINS Jun 1982 203 p
(Contract DE-AC01-76ET-10615)
(DE82-017041, DOE/ET-10615/17, FE-2030-17) Avail. NTIS HC A10/MF A01

The Sample Bank for characterization of coal includes full seam channel samples as well as samples of lithotypes, seam benches, and subseam sections. The data include proximate analysis, ultimate analysis, sulfur froms analysis, calorific value, maceral analysis, vitrinite reflectance analysis, ash fusion analysis, free-swelling index determination, Gray-King coke type determination, Hardgrove grindability determination, Vicker's microhardness determination, major and minor element analysis, trace element analysis, and mineral species analysis. The pyrolysis of coal was studied. The reactivity of chars, produced from all ranks of American coals, was studied for reactivity to air, CO₂, H₂ and steam. The catalytic effect of minerals and various cations on the gasification processes was examined. Combustion of chars, low volatile fuels, coal-oil-water-air emulsions and other subjects of research are reported. DOE

N83-25181# Pennsylvania Transportation Inst., University Park.
THE CHARACTERISTICS OF AMERICAN COALS IN RELATION TO THEIR CONVERSION INTO CLEAN-ENERGY FUELS, APPENDIX 8 B Final Report
W. SPACKMAN Jun 1982 578 p
(Contract DE-AC01-76ET-10615)
(DE82-017047; DOE/ET-10615/17-APP-8B; FE-2030-17-APP-8B) Avail. NTIS HC A25/MF A01

The characteristics of American coals as related to its conversion into clean energy fuels were analyzed. Data bases and numerical tables are presented. DOE

N83-25182# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.
MATERIALS PROBLEMS IN FLUIDIZED-BED-COMBUSTION AND COAL-GASIFICATION SYSTEMS: FURTHER STUDIES OF CORROSION CHEMISTRY IN LOW-OXYGEN ACTIVITY ATMOSPHERES Final Report
R. A. PERKINS, W. C. COONS, and S. J. VONK Jun. 1982 190 p refs
(Contract EPRI PROJ 979-6)
(DE82-905772; EPRI-CS-2452) Avail. NTIS HC A09/MF A01

The results of studies on corrosion chemistry in low-oxygen activity atmospheres that are characteristic of gasified or incompletely combusted coal are given. The objective was to identify those factors in alloy composition and structure and in gas composition and temperature that govern both the formation and eventual breakdown of protective-oxide scales in low-P sub O₂ to high-P sub S₂ atmospheres. It was found that protective chromic-oxide scales of uniform composition and structure formed only on cold-worked or ultrafine grain surfaces of alloys containing more than one percent Fe or Mn. Breakdown or failure of normally protective chromic-oxide scales was studied as a function of alloy composition (Fe, Ni, Co, Mn, Cr) and atmosphere conditions. The most protective scales were those formed on Ni-Cr alloys low in Fe and Mn. These scales failed eventually by mechanical breakdown; i.e., cracking or spalling. DOE

N83-25183# Department of Energy, Bartlesville, Okla.
LIQUID FOSSIL-FUEL TECHNOLOGY Quarterly Technical Report, Jan. - Mar. 1982
Jul. 1982 76 p
(DE82-020005, DOE/BETC/QPR-82/1) Avail. NTIS HC A05/MF A01

Highlights of research activities at Bartlesville Energy Technology Center for the quarter ending March 1982 are summarized. Major research areas are: liquid fossil fuel cycle, extraction (resource assessment and enhanced production); processing (characterization, thermodynamics, processing technology); utilization; and product integration and technology transfer. Special reports include: EOR data base, major new industry tool; properties of crude oils available via telephone hookup; alternative fuels data bank stresses transportation. DOE

N83-25184# Arkansas Power and Light Co., Little Rock.
CENTRAL ARKANSAS ENERGY PROJECT. COAL TO MEDIUM-BTU GAS Executive Summary
May 1982 16 p
(Contract DE-FG01-81RA-50552)
(DE82-017577, DOE/RA-50552/1220) Avail. NTIS HC A02/MF A01

The Central Arkansas Energy Project has as its objective the conversion of coal in a central location to a more readily usable energy source, medium Btu gas (MBG), for use at dispersed locations as fuel for power production and steam generation, or as a feedstock for chemical processing. The project elements consist of a gasification facility to produce MBG from coal, a pipeline to supply the MBG to the dispersed sites. The end of line users investigated were the repowering or refueling of an existing Arkansas Power and Light Co. Generating station, an ammonia plant, and a combined cycle cogeneration facility for the production of steam and electricity. Preliminary design of the gasification plant including process engineering design bases,

process flow diagrams, utility requirements, system description, project engineering design, equipment specifications, plot plan and section plot plans, preliminary piping and instrument diagrams, and facilities requirements. Financial analyses and sensitivities are determined. Design and construction schedules and manpower loadings are developed. It is concluded that the project is technically feasible, but the financial soundness is difficult to project due to uncertainty in energy markets of competing fuels. DOE

N83-25185# Arkansas Power and Light Co., Little Rock.
CENTRAL ARKANSAS ENERGY PROJECT: COAL TO MEDIUM-BTU GAS, VOLUME 2 Final Report
May 1982 452 p
(Contract DE-FG01-81RA-50552)
(DE82-016339; DOE/RA-50552/1220-VOL-2) Avail: NTIS HC A20/MF A01

The feasibility of coal gasification on Arkansas was analyzed. The site selection and construction of a gasification plant are discussed. DOE

N83-25186# Department of Energy, Morgantown, W. Va.
COAL-GASIFICATION MODELING WORKSHOP PROCEEDINGS
M. GHATE, ed and J. W. MARTIN, ed. 1982 468 p Workshop held in Morgantown, W. Va., 18 Jan 1982
(DE82-017279; DOE/METC-82/24; CONF-820153) Avail: NTIS HC A20/MF A01

The stage of development and availability of models and computer codes of gasifier and downstream process modeling efforts in surface gasification were summarized. Experimental efforts in gasification were reviewed. The applicability and availability of data for model testing and validation was determined. A responsive dialogue and feedback loop between modelers and experimentalists to improve the synergism between these complementary efforts was established and information concerning requirements to obtain gasifier and downstream process models and computer codes which are verified and validated over known operating ranges are provided. DOE

N83-25187# Hydrocarbon Research, Inc., Lawrenceville, N. J.
LABORATORY PROGRAM TO SUPPORT H-COAL PILOT-PLANT OPERATIONS: VOLUME 2: PDU RUN 8
Feb 1982 122 p
(Contract DE-AC05-77ET-10152)
(DE82-008213; DOE/ET-10152/T11-VOL-2, FE-2547-46-VOL-2)
Avail: NTIS HC A06/MF A01

The H-coal pilot plant operations are reported. Topics discussed are: PDU solvent precipitation; solids separation; unit operations, normal shutdown; emergency procedures, trouble shooting. DOE

N83-25205# Arizona Univ., Tucson. Dept of Chemical Engineering
GEOHERMAL DEVELOPMENT PLAN: PINAL COUNTY
D. H. WHITE and L. A. GOLDSTONE Aug 1982 43 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004879; DOE/RA-50076/5) Avail: NTIS HC A03/MF A01

The market potential for utilizing geothermal energy was evaluated. Three suspected geothermal resource areas with potential 700 C temperatures were identified. One geothermal test well near Coolidge encountered bottom hole temperatures of 1200 C at a depth of 2440 m and produced 18.3 l/sec. It is found that geothermal resources occur near population centers where average growth rates of 1.5% to 2% per year are expected over the next 40 years. Mining, agriculture and manufacturing are all important sectors of the regional economy and provide opportunities for direct utilization of geothermal energy and 25 agricultural firms were identified as having some potential for geothermal use, including the prepared feeds industry. DOE

N83-25206# Arizona Univ., Tucson. Dept. of Chemical Engineering.

GEOHERMAL DEVELOPMENT PLAN: COCHISE/SANTA CRUZ COUNTIES

D. H. WHITE and L. A. GOLDSTONE Aug. 1982 49 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004880; DOE/RA-50076/6) Avail: NTIS HC A03/MF A01

The regional market potential for utilizing geothermal energy was evaluated. Three potential geothermal resource areas with potential for resource temperatures less than 900C (1940F) were identified. Population growth rates are expected to average 3% per year over the next 30 years in Willcox; Bowie and San Simon are expected to grow much slower. Regional employment is based on agriculture and copper mining, though future growth in trade, services and international trade is expected. A regional energy use analysis is included. Urban use, copper mining and agriculture are the principal water users in the region and substantial reductions in water use are anticipated in the future. The development plan identifies potential geothermal energy users in the region. Geothermal energy utilization projections suggest that by the year 2000, geothermal energy might economically provide the energy equivalent of 3,250,000 barrels of oil per year to the industrial sector. In addition, geothermal energy utilization might help stimulate an agricultural and livestock processing industry. DOE

N83-25207# Arizona Univ., Tucson Dept of Chemical Engineering

GEOHERMAL DEVELOPMENT PLAN: GRAHAM/GREENLEE COUNTIES

D. H. WHITE and L. A. GOLDSTONE Aug 1982 56 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004881; DOE/RA-50076/8) Avail: NTIS HC A04/MF A01

The region wide market potential for utilizing geothermal energy was evaluated. Five potential geothermal resource areas with temperature less than 1000C were identified. Seven areas are inferred to contain higher temperature resources and the Clifton Hot Springs have electrical potential. Geothermal resources occur near Safford and Clifton, the two major population centers. Future population growth in the two counties is expected to average less than 2% per year over the next 40 years. Growth in the mining, trade and services economic sectors provide opportunities for the direct utilization of geothermal energy. A regional energy use analysis is included containing energy use and price projections. Water supplies are found to be adequate for urban needs, through agricultural and mineral water use may be limited in the future. A preliminary economic analysis for two distinct heating systems and a section matching geothermal resources to potential users is presented. DOE

N83-25208# Arizona Univ., Tucson. Dept of Chemical Engineering

GEOHERMAL DEVELOPMENT PLAN: YUMA COUNTY

D. H. WHITE and L. A. GOLDSTONE Aug 1982 41 p refs
(Contract DE-FC03-80RA-50076)
(DE83-004882; DOE/RA-50076/7) Avail: NTIS HC A03/MF A01

The potential for utilizing geothermal energy was evaluated. Four potential geothermal resource areas with temperatures less than 900C (1940F) were identified, and in addition, two areas are inferred to contain geothermal resources with intermediate temperature potential. The resource areas are isolated. One resource site contains a hot dry rock resource. Anticipated population growth in the county is expected to be 2% per year over the next 40 years. The primary employment sector is agriculture, though some light industry is located in the county. Water supplies are found to be adequate to support future growth without adverse affect on agriculture. In addition, several agricultural processors were found, concentrated in citrus processing and livestock raising. It is suggested that by the year 2000, geothermal energy may economically provide the energy equivalent of 53,000 barrels of oil per year to the industrial sector if developed privately.

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Geothermal utilization projections increase to 132,000 barrels of oil per year by 2000 if a municipal utility developed the resource.

DOE

N83-25209# VTN Consolidated, Inc., Irvine, Calif.
HEBER KNOWN GEOTHERMAL RESOURCES AREA
ETHANOL-FUEL FACILITY Final Technical Report

Sep. 1982 300 p refs

(Contract DE-FG03-80SF-11429)

(DE83-004775; DOE/SF-11429/1) Avail: NTIS HC A13/MF A01

A 20 million gallon per year ethanol fuel facility which will be built in a geothermal resource area is described. The feasibility study covers geothermal resource evaluation, process engineering, facilities engineering, marketing, economics and finance, and environmental analysis.

DOE

N83-25214# Arizona Univ., Tucson. Dept. of Chemical Engineering.

GEOTHERMAL DEVELOPMENT PLAN: MARICOPA COUNTY

D. H. WHITE and L. A. GOLDSTONE Aug. 1982 80 p refs

(Contract DE-FC03-80RA-50076)

(DE83-004876; DOE/RA-50076/2) Avail: NTIS HC A05/MF

A01

The Maricopa County Geothermal Development Plan evaluated the market potential for utilizing geothermal energy. The study identified six potential geothermal resource areas with temperatures less than 1000C (2120F) and in addition, four suspected intermediate temperature areas (900 to 1500C, 1940 to 3000F). Geothermal resources are found to occur in and near the Phoenix metropolitan area where average population growth rates of two to three percent per year are expected over the next 40 years. Rapid growth in the manufacturing, trade and service sectors of the regional economy provides opportunities for the direct utilization of geothermal energy. A regional energy use analysis is included containing energy use and price projections. Water supplies are found to be adequate to support this growth, though agricultural water use is expected to diminish. The study also contains a detailed section matching geothermal resources to potential users. Two comparative analyses providing economic details for space heating projects are incorporated.

DOE

N83-25216# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.

IDENTIFICATION OF DATA GAPS AND RESEARCH NEEDS FOR SOLID WASTES FROM SYN-FUEL TECHNOLOGIES

L. FRADKIN and D. G. STREETS Mar 1982 45 p refs

(Contract W-31-109-ENG-38)

(DE83-000936; ANL/EES-TM-191) Avail: NTIS HC A03/MF

A01

Solid wastes from coal gasification, coal liquefaction, and oil shale technologies are developing the basic and applied technology and data on which present and future fuel conversion and utilization processes depend. Data gaps are identified and research needs where warranted are recommended.

DOE

N83-25261# Utah Univ., Salt Lake City. Research Inst
LITHOLOGIC INTERPRETATION OF THE DE BRAGA NO. 2 AND RICHARD WEISHAUP NO. 1 GEOTHERMAL WELLS, STILLWATER PROJECT, CHURCHILL COUNTY, NEVADA

B. S. SIBBETT and R. E. BLACKETT Feb. 1982 38 p refs

(Contract DE-AC07-79ID-12079)

(DE82-019935; DOE/ID-12079/57; ESL-70) Avail: NTIS HC

A03/MF A01

Lithologies penetrated throughout the upper 732 to 838 m within the Stillwater prospect area are terrigenous sediments of Pleistocene to Recent age. A sill of dacite to andesite composition with a thickness variable between 122 to 208 (400 to 680 ft) is present below the terrigenous sediments. Between the base of the sill and the top of the Bunejug Formation are intercalated volcanic and sedimentary rocks. All formations overlying the Bunejug Formation are probably of Pleistocene age. The basalt and basaltic andesite flows and ash below the depth of approximately 1128 m are herein assigned to the Bunejug

Formation of Pliocene and possibly early Pleistocene age. The Bunejug Formation is a thick sequence of basalt to andesite flows and hyaloclastite exposed in the mountains surrounding the south half of the Carson Desert. The De Braga No. 2 well bottomed in Bunejug volcanics at a depth of 2109 m. The Richard Weishaupt No. 1 well penetrated the entire Bunejug sequence and entered felsic volcanics and tuffaceous sediments, which possibly represent part of the Truckee Formation, at a depth of approximately 2412 m

DOE

N83-25262# Los Alamos Scientific Lab., N. Mex.

INDUCED FRACTURES: WELL STIMULATION THROUGH FRACTURING

R. J. HANOLD 1982 11 p refs Presented at 3d AAPG Circum-Pacific Energy and Materials Conf., Honolulu, Hawaii, 22 Aug 1982

(Contract W-7405-ENG-36)

(DE82-019554; LA-UR-82-1971; CONF-820834-2) Avail: NTIS HC A02/MF A01

Seven fracture stimulation treatments were planned and executed. It is shown that geothermal well stimulation offers a technical alternative to additional well drilling and redrilling for productivity enhancement which can substantially reduce development costs. Well stimulation treatments were performed. Six of the seven stimulation experiments were technically successful in stimulating the wells. The two fracture treatments in East Mesa more than doubled the production rate of the previously marginal producer. The two fracture treatments at Raft River and the two at Baca were all successful in obtaining significant production from previously nonproductive intervals.

DOE

N83-25334# California Univ., Berkeley Lawrence Berkeley Lab
Dept. of Chemistry

ENERGY SOURCES AND CLIMATE

M. CALVIN 27 May 1982 15 p refs

(Contract DE-AC03-76SF-00098)

(DE82-020612; LBL-14496) Avail: NTIS HC A02/MF A01

The existing data on the effect of the use of fossil carbon as an energy source over the last two centuries on the atmospheric composition of the Earth were analyzed. It is concluded that there is a set of independent observations which, taken together, make likely a global climatic change as a result of the increased carbon dioxide level from these fossil energy sources. Alternative sources are recommended

DOE

N83-25830# Pennsylvania State Univ., University Park. Applied Research Lab.

TEMPERATURE AND PARTICLE SIZE DEPENDENCE OF SODIUM BICARBONATE INHIBITION OF METHANE/AIR FLAMES M.S. Thesis

H. T. KIM 3 Nov. 1982 88 p refs

(Contract N00024-79-C-6043)

(AD-A125105; ARL/PSU/TM-82-235) Avail: NTIS HC A05/MF A01 CSCL 20B

Coal mining/handling operations, as well as those of other powder-using industries, are occasionally interrupted by explosions and fires as a consequence of uncontrolled, fugitive flammable dusts. Damage to life and loss of capital are the unsatisfactory results. Hence, the development of powerful fire extinguishing/suppressing agents to stop these holocausts has become an increasingly important scientific challenge in today's energy and safety conscious world

Author (GRA)

N83-25837# Physical Sciences, Inc., Andover, Mass.

EFFECTS OF PREIGNITION ON PULVERIZED-COAL COMBUSTION Final Report, 19 Sep. 1980 - 30 Sep. 1982

G. A. SIMONS, G. KOTHANDARAMAN, S. P. SCHERTZER, and M. J. PALM Dec 1982 183 p refs

(Contract DE-AC22-80PC-30293)

(DE83-004371; DOE/PC-30293/8) Avail: NTIS HC A09/MF A01

The effects of preignition of pulverized-coal combustion are discussed. The objectives of the program are to optimize the

reactivity of the coal char with respect to variations in the pore structure that occur during pretreatment, and develop a porous transport theory that can be used to extract the dominant primary secondary chemical reactions from existing pyrolysis data. The data obtained for Texas Lignite suggest that porosity (hence reactivity) is strongly dependent on the final pyrolysis temperature with the maximum porosity occurring at 1300 K. The data also indicate that, to a lesser extent, the heating rate affects pore structure. Higher heating rates increase the relative number of large pores and can enhance reactivity by a factor of two. Hence, the optimum pore structure for char reactivity may be obtained by preparing char at 1300 K and high heating rates (more than 100 K/s). Such chars could be four times as reactive as chars prepared at 2000 K and 1 to 10 K/s. DOE

N83-25839# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

FLAME PROPAGATION WALL HEAT TRANSFER, AND THEIR INTERACTION IN LEAN PREMIXED GASES

J. B. WOODWARD, D. H. HIRVO, R. GREIF, and R. F. SAWYER Feb. 1982 29 p refs Presented at the 19th Intern. Symp. on Combust., Haifa, Israel, 8 Aug. 1982 (Contract W-7405-ENG-48) (DE82-008432; LBL-13950; CONF-820801-7) Avail: NTIS HC A03/MF A01

Simultaneous data on single event flame propagation, wall heat transfer, and their interaction were obtained for a constant volume chamber. Pressure variation, wall temperature variation, and high speed schlieren movies were recorded for the combustion of methane and air for various equivalence ratios. Flame speed and wall heat flux variation with respect to time were calculated from the data. The results indicate that there are important geometry effects on flame speed due to the location of the flame relative to the location of the heat transfer measurement. Peak heat flux values occur when the flame passes the location of measurement. High ignition energies are found to overdrive the rate of flame propagation. DOE

N83-25841# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany) Abteilung Stromung und Verbrennung.

A NEW COMBUSTION SYSTEM FOR BURNING LIGHT DISTILLATE FUEL OIL

H. EICKHOFF Sep. 1982 20 p refs Presented at 30th Aerodyn. Panel Meeting and 16th Intern. Flame Res. Found Meeting, San Donato Milanese, Italy (DFVLR-MITT-83-01) Avail: NTIS HC A02/MF A01; DFVLR, Cologne DM 10,90

A controllable small air blast burner unit was developed which works well in the power range necessary for an optimum operation with regard to the overall efficiency of a residential heating system. The pollutant emissions, CO as well as NO are low. Due to the nature of the system the air pressure drop is far above that of conventional domestic burners. Present development of the combustion system is mainly directed towards a reduction of the air pressure drop and the amount of excess air Author (ESA)

N83-25842# State Univ. of New York at Buffalo, Amherst. **EVALUATION OF COMBUSTION AND CLEANUP OF SRC-2 COAL-DERIVED LIQUID FUEL**

S. W. WELLER, L. A. KENNEDY, and D. T. SHAW Oct. 1982 35 p Sponsored by New York State Energy Research and Development Authority (PB83-147355; NYERDA-82-09) Avail: NTIS HC A03/MF A01 CSCL 21B

An exploratory study of the long-term stability and combustion characteristics of SRC-II, a coal-derived liquid fuel oil, is described. It was designed to investigate the effects of long-term aging on physical characteristics, the characterization of potential NOx and SOx and the combustion products' interaction with hot gas cleanup hardware. It is shown that fuels such as SRC-II may absorb excessive amounts of oxygen and that aging SRC-II at 50C produces a steady increase in the fuel's viscosity. While the report concludes

that this fuel meets hardware and environmental restraints in the laboratory, long-term tests need to be conducted to determine whether this holds true in field situations. GRA

N83-25845# Regional Research Lab., Jorhat (India).

DEHYDRATION OF ETHANOL TO ETHYLENE: STATUS OF TECHNOLOGY

G. S. PATIL, comp. and K. V. RAGHAVAN, comp. 1982 53 p (PB83-144931) Avail: NTIS HC A04/MF A01 CSCL 07D

Details of production of Ethylene from Ethanol are given. The various advantages and disadvantages of production of Ethylene from Ethanol are also discussed. This report is divided into 5 sections namely, Introduction; Catalyst Studies; Mechanisms and Kinetics; Technological aspects; and references. Author

N83-25846# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.

LASER MICROPYROLYSIS OF COAL MACERALS Annual Report, 1 Oct. 1981 - 30 Sep. 1982

F. J. VASTOLA 23 Sep. 1982 27 p Sponsored by Gas Research Inst. (PB83-161422; GRI-81/0107) Avail: NTIS HC A03/MF A01 CSCL 07D

A mass analysis of the pyrolysis products, generated by heating selected coal macerals with the focused output of a pulsed ruby laser, is obtained by pyrolyzing a monolithic coal sample in the ionization chamber of a time of flight mass spectrometer. A high speed data acquisition system is used to record 32 spectra during the pyrolysis process (1-4 ms). A high degree of reproducibility is obtained by averaging sequential spectra. Although unit mass resolution is not obtained, all coals investigated exhibited mass groupings that were classified into 15 defined mass ranges. The relative intensities and envelope shape of these mass clusters were used to determine the degree of aromaticity and hydroaromaticity as well as the presence of oxygen groups in the coal macerals. GRA

N83-25849# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LASER SYSTEM FOR NATURAL GAS DETECTION. PHASE 1: LABORATORY FEASIBILITY STUDIES Annual Report, Oct. 1980 - Dec. 1981

W. B. GRANT and E. D. HINKLEY 21 Jul. 1982 43 p refs (Contract NAS7-100) (NASA-CR-170353; NAS 1 26:170353; GRI-80/0128; REPT-5030-525) Avail: NTIS HC A03/MF A01 CSCL 07D

This project demonstrated the feasibility of using laser remote sensing technology as a tool for leak survey work in natural gas distribution systems. A laboratory device was assembled using a pair of helium neon (HeNe) lasers to measure methane. One HeNe laser emits radiation at a wavelength of 3.3922 micrometers, which corresponds to a strong absorption feature of methane, while the other emits radiation at a wavelength of 3.3911 micrometers, which corresponds to a weak absorption by methane. As a particular area is scanned for leaks, the laser is pointed at convenient topographic targets within its operating range, about 25 m. A portion of the backscattered radiation is collected by a receiver and focused onto an indium antimonide (InSb) photodetector, cooled to 77K. Methane concentrations were determined from the differential absorption at the two wavelengths for the backscattered radiation. GRA

N83-25904# Southwest Research Inst., San Antonio, Tex. Fuels and Lubricants Research Lab.

EMERGENCY FUELS TECHNOLOGY Interim Report, May 1981 - Jun. 1982

J. N. BOWDEN and L. I. STAVINOHAN Jun. 1982 84 p refs (Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L7-72733-AH-20) (AD-A125275; AFLRL-155; SWRI-6800-129) Avail: NTIS HC A05/MF A01 CSCL 21D

Different types of engines in the military system require specific fuels for normal operation. Spark-ignition engines require gasoline,

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compression-ignition engines and ground gas turbine engines require diesel fuel. The requirements of each engine type are listed in Army Regulation 703-1 as primary, alternate and emergency fuels. The work reported here identifies other combustible liquids that, in extreme emergency scenarios, could be used as field emergency fuels (FEF), either as extenders of the primary fuel supply, or as acquired. Correlations are presented that permit estimating the fuel blend properties considered to be crucial for operation of engines at a minimal performance level.

Author (GRA)

N83-25905# Southwest Research Inst., San Antonio, Tex. Energy Systems Research Div.

EVALUATION OF GASOHOL IN U.S. ARMY ADMINISTRATIVE AND TACTICAL VEHICLES Final Report, 1 Apr. 1980 - 31 Dec. 1981

J. D. TOSH, A. F. STULSAS, W. W. BARDAWAY, and R. ALVAREZ. Nov. 1982. 46 p.

(Contract DE-AC03-79CS-50004)

(AD-A125274, SwRI-5739-1) Avail: NTIS HC A03/MF A01

CSCL 21D

Following the passage of the Defense Authorization Act (PL96-107) U.S. Army Mobility Equipment Research and Development Command (MERADCOM) was tasked by Department of Defense to evaluate gasohol in U.S. Army vehicles. A cooperative program between MERADCOM and the Department of Energy resulted in five vehicle fleet tests at four Army installations conducting an evaluation of gasohol in administrative and tactical vehicles. A test group (gasohol) and control group (gasoline) was established in each fleet except MERADCOM, which only used a test group. There was a grand total of 104 test vehicles and 69 control vehicles in the evaluation. The test groups accumulated 496,985 miles while the control groups accumulated 378,756 miles. Two of the five installations reported no performance problems for either test or control groups. For the remaining three fleets, 17% (18 of 104) of the test vehicles and 9% (6 of 69) of the control vehicles experienced one or more performance problems. The 18 test vehicles reported 30% more problems than did the 6 control vehicles. This agrees with trends observed in the DOE Reliability Fleet Test in which gasohol-powered vehicles have a higher frequency of incidents in traffic.

GRA

N83-25906# Pandalai Coatings Co., Brackenridge, Pa. **INVESTIGATIVE STUDY ON ALCOHOL DIESEL FUEL BLENDS Final Report, 1 Oct. 1980 - 30 Jun. 1981**

K. PANDALAI, A. AYOUB, and B. PANDALAI. Jun. 1981. 50 p.

(Contract DAAK70-80-C-0252)

(AD-A125063) Avail: NTIS HC A03/MF A01 CSCL 21D

The project involved characterization, storage stability and material compatibility studies of ethanol and 2 diesel fuels. Ten samples of commercially available fuels were obtained and blended with 10% ethanol which was denatured with gasoline and a solvent blend of ethyl acetate and MIBK. Anhydrous alcohol also was used to prepare a 10% blend to examine stability and material compatibility characteristics. It has been observed that the presence of small amounts of water in the alcohol causes phase separation and great care must be taken to prevent water contamination in the fuel system. It has also been found that certain surfactants and co-solvents would stabilize the fuel blends even when water is present in the blended fuels. Results of test on stability and material compatibility are presented in this report.

GRA

N83-25909# Fuel and Mineral Resources, Inc., Reston, Va.

ANNOTATED REVIEW OF THE TECHNOLOGICAL STATE-OF-THE-ART OF ETHYL AND METHYL ALCOHOL-BASED FUELS AND DETERMINATION OF THE ECONOMIC FEASIBILITY OF COMMERCIAL-SCALE PRODUCTION OF SUCH FUELS

25 Aug 1982. 452 p. refs

(Contract EDA-99-06-07106)

(PB83-146308; EDA-82-0060) Avail: NTIS HC A20/MF A01

CSCL 21D

This study reviews the state-of-the-art in alcohol fuels production and utilization technologies and assesses the technical and economic feasibility of commercial production of alcohol-based fuels.

GRA

N83-26051# Monsanto Research Corp., Miamisburg, Ohio.

INSTRUMENTATION FOR OPTIMIZING AN UNDERGROUND COAL-GASIFICATION PROCESS

W. SEABAUGH and R. E. ZIELINSKI. Jun. 1982. 8 p. refs

Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, Houston, Tex., 7 Jun. 1982

(Contract DE-AC04-76DP-00053)

(DE82-015843, MLM-2951-(OP); CONF-820612-2) Avail: NTIS

HC A02/MF A01

While the United States has a coal resource base of 6.4 trillion tons, only seven percent is presently recoverable by mining. The process of in-situ gasification can recover another twenty-eight percent of the vast resource, however, viable technology must be developed for effective in-situ recovery. The key to this technology is a system that can optimize and control the process in real-time. An instrumentation system is described that optimizes the composition of the injection gas, controls the in-situ process and conditions the product gas for maximum utilization. The key elements of this system are Monsanto PRISM Systems, a real-time analytical system, and a real-time data acquisition and control system. This system provides for complete automation of the process but can easily be overridden by manual control. The use of this cost effective system can provide process optimization and is an effective element in developing a viable in-situ technology.

DOE

N83-26088# Oak Ridge National Lab., Tenn. Engineering Technology Div.

A TECHNO-ECONOMIC ASSESSMENT ON THE UTILIZATION OF SURGE-LEG PUMPS IN COAL LIQUEFACTION

T. B. CONLEY. Jan. 1983. 77 p. refs

(Contract W-7405-ENG-26)

(DE83-005175; ORNL/TM-8406) Avail: NTIS HC A05/MF A01

Conventional reciprocating slurry pumps have experienced numerous failures in coal-liquefaction pilot plants and process development units. The frequency of these failures dictates caution with respect to their use in projected commercial liquefaction facilities. The question was raised of the viability of reciprocating pumps with clean liquid surge legs as an alternative to conventional reciprocating models for use as the primary pumps for dissolver feed and vacuum tower bottoms. In order to evaluate this question, a techno-economic assessment of the adaptability of surge leg pumps to these applications was performed. The advantages and disadvantages of surge leg pumps were considered and compared to those of the conventional pumps used in the pilot plants and to those projected for use in the commercial plants. The assessment included an examination of the pumps' technical, practical, and economic viability in liquefaction services and of the design areas where further study is desirable.

DOE

N83-26153*# Earth Satellite Corp., Chevy Chase, Md.
IMPLICATIONS OF INFORMATION FROM LANDSAT-4 FOR PRIVATE INDUSTRY

J. R. EVERETT and J. D. DYKSTRA, Principal Investigators
 1983 7 p Sponsored by NASA ERTS
 (E83-10330; NASA-CR-170385; NAS 1.26.170385) Avail: NTIS HC A02/MF A01 CSCL 05B

The broader spectral coverage and higher resolution of LANDSAT-4 Thematic Mapper (TM) data open the door for identification from space of spectral phenomena associated with mineralization and microseepage of hydrocarbon. Digitally enhanced image products generated from TM data allow the mapping of many major and minor structural features that mark or influence emplacement of mineralization and accumulation of hydrocarbons. These improvements in capabilities over multispectral scanner data should accelerate the acceptance and integration of satellite data as a routinely used exploration tool that allows rapid examination of large areas in considerable detail. Imagery of Southern Ontario, Canada as well as of Cement, Oklahoma and Death Valley, California is discussed. A.R.H.

N83-26155*# Marshall Univ., Huntington, W. Va.
PROCEEDINGS OF THE NATIONAL CONFERENCE ON ENERGY RESOURCE MANAGEMENT. VOLUME 1: TECHNIQUES, PROCEDURES AND DATA BASES

J O BRUMFIELD, ed. and Y. M. SCHIFFMAN, ed. 1982 306 p refs Conf held in Baltimore, 9-12 Sep. 1982; sponsored by NASA, American Planning Association, Nuclear Regulatory Commission and US Region of the Remote Sensing Society. Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS 2 Vol
 (E83-10335; NASA-CP-2261-VOL-1; NAS 1 55 2261-VOL-1)
 Avail: NTIS HC A14/MF A01 CSCL 05B

Topics dealing with the integration of remotely sensed data with geographic information system for application in energy resources management are discussed. Associated remote sensing and image analysis techniques are also addressed.

N83-26161*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

GROUND TRUTH SAMPLING AND LANDSAT ACCURACY ASSESSMENT

J. W. ROBINSON (Computer Sciences Corp., Greenbelt, Md.), F. J. GUNTHER (Computer Sciences Corp., Greenbelt, Md.), and W. J. CAMPBELL. In Marshall Univ. Proc of the Natl. Conf. on Energy Resource Management, Vol 1 p 69-82 1982 refs ERTS

Avail: NTIS HC A14/MF A01 CSCL 05B

It is noted that the key factor in any accuracy assessment of remote sensing data is the method used for determining the ground truth, independent of the remote sensing data itself. The sampling and accuracy procedures developed for nuclear power plant siting study are described. The purpose of the sampling procedure was to provide data for developing supervised classifications for two study sites and for assessing the accuracy of that and the other procedures used. The purpose of the accuracy assessment was to allow the comparison of the cost and accuracy of various classification procedures as applied to various data types. M.G.

N83-26164*# George Washington Univ., Washington, D.C. Dept. of Geology.

POTENTIAL OF A NEW TECHNIQUE FOR REMOTE SENSING OF HYDROCARBON ACCUMULATIONS AND BLIND URANIUM DEPOSITS: BURIED LIF THERMOLUMINESCENCE DOSIMETERS

F. R. SIEGEL, J. E. VAZ (Inst. Venezolano de Investigaciones Cientificas, Caracas), and R. C. LINDHOLM (George Washington Univ., Washington, D.C.) In Marshall Univ. Proc of the Natl. Conf. on Energy Resource Management, Vol. 1 p 122-132 1982 refs ERTS

Avail: NTIS HC A14/MF A01 CSCL 08G

Buried thermoluminescence dosimeters may be useful in remote sensing of petroleum and natural gas accumulations and blind uranium deposits. They act as integrating detectors that smooth out the effects of environmental variations that affect other measuring systems and result in irregularities and poor repeatability in measurements made during gas and radiometric surveys.

Author

N83-26165*# Autometric Corp., Inc., Falls Church, Va.
GIS INTEGRATION FOR QUANTITATIVELY DETERMINING THE CAPABILITIES OF FIVE REMOTE SENSORS FOR RESOURCE EXPLORATION

R. PASCUCCHI and A. SMITH. In Marshall Univ. Proc. of the Natl. Conf. on Energy Resource Management, Vol. 1 p 135-148 1982 refs ERTS

Avail: NTIS HC A14/MF A01 CSCL 08G

To assist the U.S. Geological Survey in carrying out a Congressional mandate to investigate the use of side-looking airborne radar (SLAR) for resources exploration, a research program was conducted to define the contribution of SLAR imagery to structural geologic mapping and to compare this with contributions from other remote sensing systems. Imagery from two SLAR systems and from three other remote sensing systems was interpreted, and the resulting information was digitized, quantified and intercompared using a computer-assisted geographic information system (GIS). The study area covers approximately 10,000 square miles within the Naval Petroleum Reserve, Alaska, and is situated between the foothills of the Brooks Range and the North Slope. The principal objectives were: (1) to establish quantitatively, the total information contribution of each of the five remote sensing systems to the mapping of structural geology, (2) to determine the amount of information detected in common when the sensors are used in combination; and (3) to determine the amount of unique, incremental information detected by each sensor when used in combination with others. The remote sensor imagery that was investigated included real-aperture and synthetic-aperture radar imagery, standard and digitally enhanced LANDSAT MSS imagery, and aerial photos M.G.

N83-26176*# Marshall Univ., Huntington, W. Va.
PROCEEDINGS OF THE NATIONAL CONFERENCE ON ENERGY RESOURCE MANAGEMENT. VOLUME 2: APPLICATIONS

J O. BRUMFIELD, ed. and Y. M. SCHIFFMAN, ed. 1982 415 p refs Conf. held in Baltimore, 9-12 Sep. 1982; sponsored by NASA, American Planning Association, Nuclear Regulatory Commission and US Region of the Remote Sensing Society. Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS 2 Vol.
 (E83-10336; NASA-CP-2261-VOL-2; NAS 1.55:2261-VOL-2)

Avail: NTIS HC A18/MF A01

Subject areas related to the integration of remotely sensed data with geographic information systems for application in energy resource management are covered. The current trends and advances in the application of these systems to a number of energy concerns are addressed.

04 FUELS AND OTHER SOURCES OF ENERGY

**N83-26182*# Dames and Moore, Los Angeles, Calif.
IMPACT OF DEMOGRAPHIC SITING CRITERIA AND
ENVIRONMENTAL SUITABILITY ON LAND AVAILABILITY FOR
NUCLEAR REACTOR SITING**

K. L. HANSEN /in Marshall Univ Proc. of the Natl Conf on
Energy Resource Management, Vol. 2 p 373-392 1982 refs
ERTS

Avail: NTIS HC A18/MF A01 CSCL 08B

The effect of population and certain environmental characteristics on the availability of land for siting nuclear power plants was assessed. The study area, consisting of the 48 contiguous states, was divided into 5 kilometer (km) square grid cells yielding a total of 600,000 cells. Through the use of a modern geographic information system, it was possible to provide a detailed analysis of a quite large area. Numerous maps and statistical tables were produced, the detail of which were limited only by available data. Evaluation issues included population density, restricted lands, seismic hardening, site preparation, water availability, and cost factors. M.G.

**N83-26185*# Geological Survey, Reston, Va.
POTENTIAL ROLE OF LAND USE AND LAND COVER
INFORMATION IN POWERPLANT SITING: EXAMPLE OF THREE
MILE ISLAND**

J. R. WRAY /in Marshall Univ Proc. of the Natl Conf. on
Energy Resource Management, Vol 2 p 427-431 1982
ERTS

Avail: NTIS HC A18/MF A01 CSCL 08B

Selecting a site for a nuclear powerplant can be helped by digitizing land use and land cover data, population data, and other pertinent data sets, and then placing them in a geographic information system. Such a system begins with a set of standardized maps for location reference and then provides for retrieval and analysis of spatial data keyed to the maps. This makes possible thematic mapping by computer, or interactive visual display for decisionmaking. It also permits correlating land use area measurements with census and other data (such as fallout dosages), and the updating of all data sets. The system is thus a tool for dealing with resource management problems and for analyzing the interaction between people and their environment. An explanation of a computer-plotted map of land use and cover for Three Mile Island and vicinity is given M.G.

**N83-26186*# Dames and Moore, Los Angeles, Calif.
COMPUTER-AIDED SITING OF COAL CONVERSION
FACILITIES**

D. D. MORENO /in Marshall Univ. Proc. of the Natl. Conf. on
Energy Resource Management, Vol. 2 p 432-446 1982 refs
ERTS

Avail: NTIS HC A18/MF A01 CSCL 08B

The value of using geographic information systems in site selection for coal conversion plants is discussed. Environmental and cultural factors and capital/operating costs were considered to determine site suitability. M.G.

**N83-26227# Bendix Field Engineering Corp., Grand Junction,
Colo.
NATIONAL URANIUM RESOURCE EVALUATION: URANIUM
HYDROGEOCHEMICAL AND STREAM-SEDIMENT
RECONNAISSANCE OF THE SHISHMAREF NTMS
QUADRANGLE, ALASKA**

Jul. 1982 24 p refs Prepared in cooperation with Los Alamos
Scientific Lab., N Mex
(Contract DE-AC13-76GJ-01664; W-7405-ENG-36)
(DE82-020189, GJBX-141-82) Avail: NTIS HC A02/MF A01

A hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the Shishmaref NTMS quadrangle was reported. Location data field analyses and laboratory analyses of several different sample media are presented. The sample media and the analytical results for each medium are summarized. The data are divided into groups of stream sediment, lake sediment, stream water, and lake water samples. For each group which contains a sufficient number of observations, statistical tables, tables of raw

data, and 1:1,000,000 scale maps of pertinent elements and maps showing results of multivariate statistical analyses are included.

DOE

**N83-26249# Nevada Univ., Reno. Desert Research Inst.
HYDROLOGIC INTERPRETATION OF SHALLOW SUBSURFACE
TEMPERATURE DATA**

N. L. INGRAHAM, R. L. JACOBSON, and M. E. CAMPANA Aug.
1982 44 p refs
(Contract DI-14-34-0001-0130)

(PB83-150136; PUB-41076; W83-01605; OWRT-A-094-NEV(A))

Avail: NTIS HC A03/MF A01 CSCL 08H

The temperatures of shallow holes (1 meter) in a portion of Dixie Valley, Nevada, were monitored for a period of almost two years; ten monthly surveys were conducted, in which as many as 219 holes were measured per month. The temperatures were used to delineate infiltration/recharge events and areas of suspected subsurface mountain-front recharge in the study region. The data indicated that qualitative delineation of infiltration events from flash floods is possible, as certain alluvial fans showed marked depression of shallow temperatures in the wake of the floods, but it was impossible to determine whether or not these infiltration events resulted in groundwater recharge. Author (GRA)

**N83-26287# Oak Ridge National Lab., Tenn. Chemical
Technology Div**

**SUMMARY OF BIOMASS RESEARCH PROGRAMS AT OAK
RIDGE NATIONAL LABORATORY**

R. K. GENUNG, R. I. VANHOOK, and D. J. BJORNSTAD 1982
4 p Presented at the TVA Southeast Region Biomass Res.
Conf., Muscle Shoals, Ala., 12-13 Jul. 1982

(DE82-018169, CONF-820730-1) Avail: NTIS HC A02/MF A01

Biomass activities are described in relation to production and conversion. Economic and market analyses of biomass usage are presented. DOE

**N83-26290# Mining and Reclamation Council of America,
Washington, D.C.**

**DETERMINING THE RESEARCH NEEDS OF THE
SURFACE-COAL-MINING INDUSTRY Final Report**

L. M. ZELL Jul. 1982 146 p refs

(Contract DE-FG01-81FE-00094)

(DE82-019991, DOE/FE-00094/T1) Avail: NTIS HC A07/MF
A01

Future increases in coal production and utilization will be largely dependent upon the development of new technologies that allow coal to be mined and utilized in an environmentally sound manner. Complexities and impacts of the new surface-mining regulations have created additional concern for both the development of new mining and reclamation procedures and for the implementation of such research efforts in the field. The Department of Energy's Office of Coal Mining and the Mining and Reclamation Council of America (MARC) are committed to the identification and resolution of technical problems facing the surface-coal-mining industry. Recognizing the difficulty of assimilating, summarizing and disseminating technological advances to the coal industry, MARC conducted a nationwide study to bring together the diverse elements of the industry to develop a comprehensive list of practical and theoretical research needs which would help to mitigate these deficiencies. DOE

**N83-26295# Hammesfahr-Winter and Associates, Inc.,
Bernardsville, N.J.**

**PROGRAM FOR LARGE-SCALE
UNDERGROUND-COAL-GASIFICATION TESTS**

F. W. HAMMESFAHR and P. L. WINTER Nov. 1982 165 p
refs

(Contract DE-AC20-81LC-10703)

(DE83-004525; DOE/LC-10703/T1) Avail: NTIS HC A08/MF
A01

The continuing development of underground coal gasification technology requires extended multi-module field programs in which the output gas is linked to surface usage. An effort was to appraise

whether existing surface facilities in the utility, petroleum refinery, or natural gas industries could be used to reduce the cost of such an extended multi-module test and whether regional demand in areas having underground coal gasification coal resources could support the manufacture of transportation fuels from underground coal gasification gases. To limit the effort to a reasonable level but yet to permit a fair test of the concept, effort was focused on five states, Illinois, New Mexico, Texas, Washington, and Wyoming, which have good underground coal gasification reserves. Studies of plant distribution located 25 potential sites within 3 miles of the underground coal gasification amenable reserves in the five states. Distribution was 44% to utilities, 44% to refineries, and 12% to gas processing facilities. GRA

N83-26303# Texas Univ., Austin. Center for Energy Studies.
GULF COAST GEOPRESSURED-GEOTHERMAL RESERVOIR SIMULATION, YEAR 4 Final Report, 1 Aug. 1979 - 31 Jul. 1980

R. C. MACDONALD, K. SEPEHRNOORI, and H. OHKUMA Oct 1982 96 p refs
(Contract DE-AC08-79ET-27112)
(DE83-005668, DOE/ET-27112/3) Avail: NTIS HC A05/MF A01

The results of the short-term production tests run on the Pleasant Bayou No. 2 well are summarized. These tests were analyzed using conventional pressure test analysis methods. The effects of reservoir heterogeneities on production behavior and, in particular, permeability distribution and faulting of reservoir sand were studied to determine the sensitivity of recovery to these parameters. A study on the effect of gas buildup around a producing well is reported. DOE

N83-26305# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

FLASH PYROLYSIS OF BIOMASS WITH REACTIVE AND NONREACTIVE GASES

M. S. SUNDARAM, M. STEINBERG, and P. FALLON Oct 1982 27 p refs Presented at the Intern. Conf. on the Fundamentals of Thermochem. Biomass Conversion, Estes Park, Colo., 18-22 Oct 1982
(Contract DE-AC02-76CH-00016)
(DE83-005808; BNL-32280; CONF-821051-5) Avail: NTIS HC A03/MF A01

Studies were done on the flash pyrolysis of Douglas Fir wood in the presence of reactive and nonreactive gases including hydrogen, methane, and helium. Pyrolysis and gasification of the wood particles was done in one step, without catalysts. Almost complete (98%) gasification of the carbon in Douglas fir wood was achieved at 10000C and 500-psi hydrogen pressure. The reaction products were methane, ethane, ethylene, carbon monoxide, BTX, and water. Flash hydropyrolysis produced a large yield of hydrocarbon gases (up to 78% C) comprising methane and ethane. High yields of ethylene (up to 21% C) and BTX (up to 12% C) were obtained via methane pyrolysis of fir wood; a free radical mechanism is proposed to explain the enhanced yield of ethylene in a methane atmosphere. DOE

N83-26944# Pittsburgh Energy Technology Center, Pa.
PROCEEDINGS OF THE 4TH INTERNATIONAL SYMPOSIUM ON COAL-SLURRY COMBUSTION, VOLUME 1

1982 300 p refs Symp held in Orlando, Fla., 10-12 May 1982
(DE82-016335, CONF-820519-VOL-1) Avail: NTIS HC A13/MF A01

The proceedings of this conference are contained in four volumes. The first volume deals with research programs and demonstration projects. Overviews are presented of the research activities into coal-liquid mixtures in Brazil, Canada, China, France, Japan, Spain, Sweden, and the USA, and the coordinated research program of the International Energy Agency. Descriptions and results, when available, are given of the various demonstration projects testing the preparation, transport, storage, stability, and combustion performance of coal-oil mixtures for use in boilers

and blast furnaces. Separate abstracts were prepared for most of the papers presented at the conference. DOE

N83-26945# Physical Sciences, Inc., Andover, Mass.
SYNTHETIC-FUEL COMBUSTION: POLLUTANT FORMATION. SCOT-INITIATION MECHANISMS IN BURNING AROMATICS Final Report, 19 Sep. 1980 - 18 Sep. 1982

W. T. RAWLINS, T. TANZAWA, S. P. SCHERTZER, and R. H. KRECH Jan 1983 155 p refs
(Contract DE-AC22-80PC-30292)
(DE83-005611; DOE/PC-30292/8, PSI-TR-361) Avail: NTIS HC A08/MF A01

Soot initiation in the pyrolysis and combustion of the aromatic model fuels toluene and pyridine are described. These molecules were chosen as generic examples of the aromatic component of synthetic fuels which is thought to dominate formation in combustion of these fuels. The experiments were conducted in a shock tube over the ranges 1300 to 2500 K and 0.2 to 0.8 atm, using optical diagnostics to monitor the appearance of soot particles and the kinetic behavior of several gas phase species. Major results of this study include validation of the applicability of optical diagnostics in sooting systems, observations of strong influence of fuel molecular structure on sooting behavior; and postulation of a conceptual sooting mechanism to account for the existing data base. DOE

N83-26947# Argonne National Lab., Ill. Materials Science Div.
ANALYSIS OF A FAILED SPENT-CHAR TRANSFER LINE FROM THE IGT HYGAS COAL-GASIFICATION PILOT PLANT

M. C. SHIN (Korea Advanced Inst of Science and Technology), D. R. DIERCKS, and G. M. DRAGEL Mar. 1982 36 p refs
(Contract W-31-109-ENG-38)
(DE82-014906, ANL/FE-82-5) Avail: NTIS HC A03/MF A01

A failed spent char transfer line from the IGT HYGAS Coal Gasification Pilot Plant was analyzed. The line was fabricated primarily of RA 330, except for one length of Incoloy 800 piping and Type 316 stainless steel hub pieces at each end of the horizontal line. At one of these locations, namely the downstream hub, the cracking was accompanied by substantial corrosive attack. Little or no corrosion was noted at the other two failure sites. The failures were attributed to a combination of: (1) thermal stresses produced by temperature cycles experienced during the discharge of hot char, and (2) sulfidation caused by prolonged or repeated contact of the line with sulfur containing hot char. It was recommended that the horizontal portion of the line be redesigned to reduce mechanical constraints, that the severity of the imposed temperature cycles be reduced if possible, and that the hub pieces be fabricated of a more sulfidation resistant alloy. DOE

N83-26952# Exxon Nuclear Idaho Co., Inc., Idaho Falls.
AUTOIGNITION OF KEROSENE/OXYGEN MIXTURES IN A FLUIDIZED BED

L. L. TAYLOR May 1982 110 p refs
(Contract DE-AC07-79ID-01675)
(DE82-016376; ENICO-1112) Avail: NTIS HC A06/MF A01

Startup of the in-bed combustion system in the Waste Calcining Facility uses a heated fluidizing air stream to bring the fluidized bed to the autoignition temperature of kerosene/oxygen. Measurable ignition lag times in excess of 300 seconds were encountered along with demonstrated autoignition of kerosene/oxygen mixtures in a fluid bed at temperatures below 300 C. Pilot plant data to date indicates that the 360 C temperature limit imposed for autoignition could be lowered to 340 C without compromising existing safety considerations. Pilot plant tests examined: (1) O₂/fuel ratios; (2) atomizing nozzle spray patterns; (3) fuel/oxygen mass velocities, and (4) various bed materials for their effect on autoignition temperatures of kerosene/oxygen in a fluid bed. DOE

04 FUELS AND OTHER SOURCES OF ENERGY

N83-26957# SRI International Corp., Menlo Park, Calif Chemistry Lab.

IDENTIFICATION AND CLEAVAGE OF BREAKABLE SINGLE BONDS BY SELECTIVE OXIDATION, REDUCTION, AND HYDROLYSIS

A. S. HIRSCHON, J. ZEVELY, and F. R. MAYO 25 May 1982
22 p refs

(Contract DE-AC22-78ET-11423)

(DE82-016800; DOE/ET-11423/T4) Avail: NTIS HC A02/MF A01

The proportions of the various kinds of connecting links in coal were determined and determination of the structure of bituminous coal, with emphasis on the cross-links and breakable single bonds. An extraction of Illinois No. 6 coal, some swelling experiments of Illinois No. 6 coal products, and some extractions of other recently acquired coal samples re described. The results show that on long heating at a high solvent to coal ratio ethanolamine does not extract as much material from whole coal as either BnNH₂ or EDA, yet the swelling ratio of the extracted coal is greater than with the other amines BnNH₂ swells both EDA/DMSO- and pyridine extracted coals better than other amine solvents tested, including ethanolamine. The EDA/DMSO-extracted coal is swollen more by all the solvents tested than pyridine extracted coal. DOE

N83-26958# Energy and Environmental Research Corp., Irvine, Calif

SOOT FORMATION IN SYNTHETIC-FUEL DROPLETS

J. C. KRAMLICH, W. R. SEEKER, and R. PAYNE Jun 1982
47 p refs

(Contract DE-AC22-80PC-30298)

(DE82-018420; DOE/PC-30298/T7) Avail: NTIS HC A03/MF A01

A phenomenological understanding of droplet combustion and associated carbonaceous particulate formation for synthetic fuel oils was developed. The physical processes that occur to a droplet in a spray flame are schematically represented. The actual path that a droplet takes after it is injected into the hot flame zone was found to depend not only on the fuel properties but the flame zone environment. Secondary atomization, droplet dispersion and fuel effects are discussed. Soot yield and the physical processes occurring during droplet burning were influenced by fuel parameters. For dispersed conditions, the yield of soot was found to increase markedly with the fuel C/H ratio whether the gas-phase environment was lean or rich. In addition, to the secondary atomization that occurred with some fuel blends, the droplet termination mechanism was also strongly influenced by fuel effects. DOE

N83-26959# General Electric Co., Schenectady, N. Y. Corporation Research and Development Dept

CATALYTIC CO₂ GASIFICATION OF GRAPHITE VS. COAL CHAR

C. L. SPIRO, D. W. MCKEE, P. G. KOSKY, and E. J. LAMBY 1982 11 p refs

(Contract DE-AC21-80MC-14591)

(DE82-016412; DOE/MC-14591/T2) Avail: NTIS HC A02/MF A01

The effects of alkali carbonate catalysts on the CO₂ gasification of Illinois No. 6 HVB bituminous coal char, demineralized Illinois No. 6 coal char, Pittsburgh No. 8 HVA coal char, Navajo subbituminous coal char, Reading anthracite coal char, North Dakota A lignite char and spectroscopic grade highest purity graphite were reported. Alkali carbonate salts are effective Boudouard catalysts for all these substrates, but salient differences between coal char vs graphite reactivity are observed. Structural differences in chars vs graphite which might be responsible for these effects were identified. By eliminating minerals and surface phenomena, residual hydrogen was identified as the main cause of reactivity differences. No mechanisms completely account for the observed gasification behavior in the presence of these salts, particularly as a function of loading. Indeed, the fundamental

aspects of the periodic trend of salt efficacy is far from understood. DOE

N83-26960# General Electric Co., Schenectady, N. Y. Corporate Research and Development Center

COAL-GASIFICATION CATALYSIS MECHANISMS

P. G. KOSKY, E. J. LAMBY, D. H. MAYLOTTE, D. W. MCKEE, and C. L. SPIRO Apr 1982 157 p refs

(Contract DE-AC21-80MC-14591)

(DE82-013824; DOE/MC-14591/1173) Avail: NTIS HC A08/MF A01

The catalytic gasification of chars by H₂O(g), D₂O(g), CO₂ and mixtures of H₂O(g)/CO and CO₂/CO was studied. The catalysts were common alkali salts or eutectic mixtures thereof, the alkaline earths and a transition metal based series (Ni). The most active catalysts were those in the alkali series with a definite cationic trend which, in CO₂, was in the molar concentration ranked order Cs > K > Na. The alkaline earth series behaved differently from the alkali series. To test the hypothesis that a reduction/oxidation cycle was in effect rather than an OH exchange site, exchange reactions were run with D₂O substituting for H₂O. Based on the strength of the OH/OD stretching bonds it was concluded that the rate constants should vary by a factor of about 1.5 to 2.5 in the temperature range of interest. This was quantitatively observed for the uncatalyzed but not for the catalyzed chars, unequivocally indicating a profound change of mechanism. DOE

N83-26963# General Electric Co., Schenectady, N. Y. Corporate Research and Development

H₂S REMOVAL FROM COAL GAS AT MID TEMPERATURE (150 TO 200 DEG C) Annual Report, 1 Oct. 1980 - 30 Sep. 1981

S. G. KIMURA, B. M. KIM, and J. A. SCHULTZ Feb. 1982 78 p refs

(Contract DE-AC01-80ET-15288)

(DE82-011004; DOE/ET-15288/1) Avail: NTIS HC A05/MF A01

Four potential absorbents: zinc sulfate, nickel, coal ash leachate, and redox reagents, have been identified and evaluated. The Zn SO₄ absorbent had excellent H₂S removal capability, and will simultaneously absorb ammonia. However, regeneration of the ZnS has been incomplete, and is expected to be excessively slow. Nickel works best as Ni(OH)₂. H₂S removal efficiency is excellent, and regeneration capability is good. Because the absorbent is a slurry, some plugging of the absorption column was noted. The coal ash leachate was simulated with Fe(OH)₃. This has been found to be the poorest of the absorbents, although its H₂S absorption efficiency is adequate. Because the absorbent is derived from coal ash, regeneration is not an issue. The redox process has been evaluated in several modes: 2 stage absorption/regeneration with FeNaHEDTA redox reagent, direct oxidation with the redox reagent, and water only direct oxidation, the last of which was found to be unexpectedly effective. The major concern of the processes using the redox reagent is degradation of the organic HEDTA, which was measured and found to require careful control. DOE

N83-26964# California Univ., Berkeley Dept of Chemical Engineering.

DEW POINTS OF HOT GASES FROM COAL-GASIFICATION PROCESSES Final Report

A. MONGE, A. B. MACKNICK, C. VANDEROSTYNE, and J. M. PRAUSNITZ May 1982 104 p refs

(Contract DE-AC21-79ET-14884)

(DE82-016337; DOE/ET-14884/1224) Avail: NTIS HC A06/MF A01

Effluent gases from coal gasification processes often contain high molecular weight hydrocarbons (tars) which, upon condensation, may foul heat exchangers needed to recover sensible heat. Efficient design of heat exchangers and separation equipment for the removal of tars requires information about the phase equilibrium behavior of these systems. A computer program was written to predict dew points and condensation versus temperature behavior of gasifier effluents containing coal tars. Predictions were tested using experimentally determined dew points

for methane/water/Lurgi coal tar fraction mixtures. The comparisons are generally good. Calculation of tar properties is based on a tar characterization procedure where vacuum distillation, at high reflux, is used to produce narrow boiling fractions. Each fraction is treated as a pseudo component; its properties are based on the vapor pressure datum obtained during fractionation, on the results of elemental analysis, and on the proton NMR spectrum of the fraction. DOE

N83-26965# Purdue Univ., Lafayette, Ind. Combustion Lab.
GASIFICATION IN PULVERIZED COAL FLAMES. INVESTIGATION OF PULVERIZED COAL-COMBUSTORS AND GASIFIERS: MULTIPLE SUB-REACTOR MODEL AND EXPERIMENTAL RESULTS, PART 2 Final Report
P. E. GEORGE and N. M. LAURENDEAU Apr. 1982 545 p refs

(Contract DE-AC01-76ET-10546; E(49-18)-2029)
(DE82-013001; DOE/ET-10546/T1; ME-TSPC-TR-82-12, FE-2029-10) Avail: NTIS HC A23/MF A01

The feasibility of using currently available pulverized coal burners to produce power or synthesis gas from coal was examined. Two configurations are considered: the annular confined jet with secondary swirl, and the vortex tube with tangential entry. The first burner is characterized by a single axial injector of high primary velocity; secondary swirl is used to control mixing and residence times. The second burner is modeled after the cyclone combustor, large residence times and slagging operation should lead to high carbon efficiencies. Species concentrations and temperature are measured both within and downstream of the gasifier chambers. These profiles are used to assess the influence of process variables such as pressure, solid/gas feed rates, swirl intensity, inlet temperature and geometrical injection pattern on both the rate and extent of coal conversion. Simple models governing entrained flow systems will be developed to further interpret the experimental data. DOE

N83-26966# Pittsburgh and Midway Coal Mining Co., Englewood, Colo.
SOLVENT REFINED COAL (SRC) PROCESS. CORROSION-EROSION STUDY Interim Report, Sep. 1980 - Sep. 1981

J. D. MCCOY Jan. 1982 57 p
(Contract DE-AC05-76ET-10104)
(DE82-011499; DOE/ET-10104/55) Avail: NTIS HC A04/MF A01

In the liquefaction process to convert coal to cleaner liquid fuels, gas-solid-liquid mixtures are encountered at high pressure and high temperature. These conditions necessitate designing and construction equipment for demonstration or commercial scale plants that provide adequate resistance to the combined effects caused by corrosion and erosion. The four objectives of the study are the corrosivity of SRC-II oil and water streams, evaluate the fouling characteristics of SRC-II liquid products, assess available technology to measure thickness of hot pipe and vessels, and evaluate the corrosion-erosion effects of hot coal-gas-oil slurries. DOE

N83-26970# Science Applications, Inc., Chatsworth, Calif.
Combustion Science and Advanced Technology Dept
SPRAY COMBUSTION OF SYNTHETIC FUELS. PHASE 2: SPRAY-COMBUSTION PHENOMENA Quarterly Report, 1 Jan. - 31 Mar. 1982

30 Apr. 1982 145 p refs
(Contract DE-AC22-81PC-40276)
(DE82-015489; DOE/PC-40276/T2; QR-2) Avail: NTIS HC A07/MF A01

Physical and chemical processes relevant to synfuel combustion, are addressed: fundamental information and data bases applicable to synfuel utilization in industrial combustors, are considered, and associated combustion models and synfuel utilization criteria with special emphasis on spray combustion are discussed. Progress reports for the following tasks are presented: (1) generation of property data base; (2) kinetic assessment; (3)

development of modular spray combustion; (4) test preparation activities; (5) application of modular spray combustion models. DOE

N83-26971# Virginia Commonwealth Univ., Richmond. Dept. of Chemistry.

NEW CATALYSTS FOR THE INDIRECT LIQUEFACTION OF COAL Quarterly Technical Report, 1 Nov. 1981 - 31 Jan. 1982

G. A. MELSON 1982 7 p refs
(Contract DE-FG22-80PC-30228)
(DE82-017190; DOE/PC-30228/T4; QTR-2) Avail: NTIS HC A02/MF A01

The evaluation of some iron/zeolite catalysts for synthesis gas conversion was conducted. Effects of % iron loading, pretreatment and support were determined. DOE

N83-26972# Brigham Young Univ., Provo, Utah. Combustion Lab.

PREDICTION AND MEASUREMENT OF OPTIMUM OPERATING CONDITIONS FOR ENTRAINED COAL-GASIFICATION PROCESSES Final Report, 1 Nov. 1979 - 31 Dec. 1981

P. O. HEDMAN, L. D. SMOOT, P. J. SMITH, and A. O. BLACKHAM Dec. 1981 193 p refs 3 Vol.
(Contract DE-AC21-80MC-14380)
(DE82-015612; DOE/MC-14380/1210-VOL-1) Avail: NTIS HC A09/MF A01

Experimental and theoretical results of a twenty-six month study of entrained coal gasification with steam and oxygen are discussed. The gasifier facility and testing methods were revised for improvement in data accuracy. Fourteen tests were conducted in a laboratory gasifier to determine effects of inlet gas composition, temperature and swirl number on carbon conversion. A major increase in carbon conversion was observed with oxygen in the feed stream with the coal. The gasifier facility was also rebuilt for pressures to 250 psi and cold flow tests demonstrated facility operation to the maximum pressure. Sulfur pollutants were measured in eleven additional gasification tests. Methods for sulfur analysis were developed and the accuracy determined. Gasifier tests were also performed to support development of optical methods for analysis of gasifier effluents. A laser-Doppler velocimeter (LDV) was demonstrated for measurement of instantaneous velocity and turbulence intensity in non-reactive flow. DOE

N83-26974# National Coal Board, Leatherhead (England). Coal Utilization Research Lab

FLUIDISED-BED COMBUSTION. INITIAL RESULTS OBTAINED IN A 1-FT BY 1-FT FLUIDISED-BED COMBUSTOR OPERATING AT PRESSURES UP TO 20 ATM

A. G. ROBERTS and J. E. STANTAN Sep. 1982 97 p
(Contract DE-AC21-80MC-14129)
(DE83-005956; DOE/MC-14129/1309) Avail: NTIS HC A05/MF A01

A 1 ft square pressurized fluidized-bed combustor was built to obtain performance data at pressures up to 20 atm. It has a tube bank containing cooled and uncooled elements in which the geometry and the proportion of cooled elements can be changed readily, so that operation over a wide range of pressures, excess air values, temperatures and velocities is possible. The maximum tube bank height that can be accommodated requires a bed depth of about 9 ft. The facility is described and the results from the first six tests are summarized. Data were acquired at different operating conditions during a total of 20 test periods, each of 15 to 24 hours duration. Most of the data were obtained at pressures of 6, 10, 16, and 20 atm; fluidizing velocity of 3 ft/s; bed temperature of 15600F, bed depths of 6 1/2 and 9 ft. The other main variables were Ca/S mol ratio and excess air. The results showed that: a combustion efficiency of 99.5% was achieved for all operating conditions; no systematic effect of pressure on SO₂ retention has been established. Excess air greatly influences NO_x emissions which were 0.5 lb/million Btu with 100% excess air and 0.25 lb/million Btu at 30% excess air and heat transfer to the cooling circuits increased with increasing pressure. DOE

N83-26983# Department of Energy, Pittsburgh, Pa.
PROCEEDINGS OF THE FOURTH INTERNATIONAL SYMPOSIUM ON COAL-SLURRY COMBUSTION, VOLUME 4
 1982 377 p refs Symp. held in Orlando, Fla., 10-12 May 1982 4 Vol.
 (DE82-016336; CONF-820519-VOL-4) Avail: NTIS HC A17/MF A01

The rheological characteristics and the factors affecting the rheology of coal-oil mixtures, coal water mixtures, coal-oil-ethanol mixtures, and charcoal-oil mixtures, and the equipment required for the handling, transport, storage, grinding, monitoring, atomization, and air pollution control of coal slurries are discussed. DOE

N83-26999# California Univ., Berkeley Dept. of Materials Science and Mineral Engineering
A NEW CLASS OF STEELS FOR THICK-WALL PRESSURE VESSELS Final Technical Report, 21 Jun. 1980 - 30 Jun. 1982
 P N SPENCER, A. C MCGEE, and E. R PARKER 1982 91 p refs
 (Contract W-7405-ENG-26)
 (DE83-004101; UCB/RP-82/D1009) Avail: NTIS HC A05/MF A01

The objective is to develop a new class of steels that can be field fabricated into very large diameter, very thick wall, pressure vessels for coal gasification/liquefaction systems, and specifically to develop an Fe-C-V-Ni based alloy which, after a simple continuous cooling process (instead of quenching and tempering), would exhibit through thickness strength and toughness combinations comparable to those of commercially available pressure vessel steels and which at the same time would be less susceptible to hydrogen attack. Previous work included detailed studies of isothermally transformed Fe-C-V base alloys and preliminary investigations of continuously cooled steels. Results indicated that uniform microstructures with combinations of strength and toughness could be produced in a wide range of section thicknesses. From June 1980 through June 1981, emphasis was placed on investigating the effect on mechanical properties/microstructure relationships of different austenitization temperatures and different rates of continuous cooling of six Fe-C-V-Ni-Mu alloys. During the June 1981 to June 1982 period, an additional three Fe-C-V compositions including additions of Al, Si, or Mo were added to the list of alloys being investigated. In addition to evaluation of continuous cooling characteristics and VC dissolution and coarsening kinetics, emphasis was placed on hydrogen attack and weldability studies. DOE

N83-27031# Atomic Energy Research Establishment, Harwell (England). Materials Development Div.
THE BENEFICIATION OF POWER STATION COAL ASH AND ITS USE IN HEAVY CLAY CERAMICS

M. ANDERSON and G. JACKSON Jan 1983 21 p refs
 (AERE-R-10806; HL83/146(C14)) Avail: NTIS HC A02/MF A01

Differences in the carbon content and the bulk density of pulverized fuel ash produced by coal-burning electric power plants, and the magnitude of these variations are considered. The influence of out-of-the-hopper material on the properties of the ash/clay mixes is examined and methods for overcoming the problem are addressed. The operation of boilers in a power station is outlined in an effort to explain the inherent short-run variability of ash. Author

N83-27034# Naval Postgraduate School, Monterey, Calif
AN INVESTIGATION OF THE EFFECTIVENESS OF SMOKE SUPPRESSANT FUEL ADDITIVES FOR TURBOJET APPLICATIONS M.S. Thesis

J. R. BRAMER Oct. 1982 72 p refs
 (AD-A125025) Avail: NTIS HC A04/MF A01 CSCL 21E

Seven fuel additives were tested to investigate their effectiveness at reducing exhaust stack gas opacity in a turbojet test cell. Exhaust particle sizes and mass concentrations were determined at the engine and stack exhausts using measurements of light transmittance at three frequencies. Particle samples were

also collected at the engine exhaust and measured with a scanning electron microscope to verify the optical technique. Nitrous oxide emissions were measured at the test cell stack exhaust. Four of the additives tested were found effective at reducing stack exhaust opacity and particulate mass concentration. None of the additives had any measurable effect on particle diameters. No meaningful changes in particle size or mass occurred between the engine and stack exhausts. The optical technique for determining particle size was verified effective using the scanning electron microscope. No additive had any significant effect on nitrous oxide production. Author (GRA)

N83-27036# Mueller Associates, Inc., Baltimore, Md.
STATUS OF ALCOHOL FUELS UTILIZATION TECHNOLOGY FOR HIGHWAY TRANSPORTATION: A 1981 PERSPECTIVE. VOLUME 2: COMPRESSION-IGNITION ENGINES

Nov. 1982 129 p refs
 (Contract DE-AC05-79CS-56051)
 (DE83-008127; DOE/CS-56051/8-VOL-2) Avail: NTIS HC A07/MF A01

The current status of the technologies of alcohol utilization in highway transportation diesel engines is reviewed. The use of methanol, ethanol, and certain of their derivatives in diesel engine powered vehicles is treated in this volume. The results of engine, vehicle and fuels testing are summarized. The topics of fuel properties, power output, fuel consumption, thermal efficiency, ignition delay, rate of pressure rise, engine noise, operability, exhaust emissions, smoke, materials compatibility, engine wear, and safety are discussed based on the data available at this time. The status of the technology at the time of the last comprehensive survey (1978) is summarized and discussed. Significant advances made since that time are delineated, as are remaining information gaps and areas in which more extensive investigation is still needed. DOE

N83-27046# Pennsylvania State Univ., University Park. Coal Research Section.

RELATION OF COAL CHARACTERISTICS TO LIQUEFACTION BEHAVIOR. PART 2: CONTINUOUS FLOW REACTOR STUDIES BY GULF RESEARCH AND DEVELOPMENT CO. Final Technical Report, Jul. 1976 - Feb. 1981

P. H. GIVEN, W. SPACKMAN, A. DAVIS, P. L. WALKER, H. L. LOVELL, M. M. COLEMAN, and P. C. PAINTER May 1982 162 p refs

(Contract DE-AC22-76ET-10587)
 (DE82-016938; DOE/ET-10587/T1-PT-2; FE-2494-FR-2) Avail: NTIS HC A08/MF A01

Gulf's 1000 gm/h continuous flow reactor (the A-1 Unit) was used for all experiments, and a number of product analyses were performed. Generating data in a continuous flow liquefaction reactor operated with a process derived solvent is a quite complicated process, and critical appraisal of the results requires an understanding of how they were obtained. The objectives and rationale of the tasks were described. Some coal studied in some of the tasks were examined. Some problems in duplicating the organic solvents used in the different equipments are described. DOE

N83-27050# National Fertilizer Development Center, Muscle Shoals, Ala

OVERVIEW OF FUEL ALCOHOL FROM AGRICULTURAL CROPS WITH EMPHASIS ON THE TENNESSEE VALLEY

J. C. ROETHELI, R. S. PILE, and H. C. YOUNG Feb. 1982 74 p refs

(Contract DE-AI01-80CS-80010)
 (DE82-016932; TVA/OACD-82/8; BULL-Y-171) Avail: NTIS HC A04/MF A01

The factors and concerns associated with producing fuel alcohol from agricultural crops were presented. Areas covered include: an assessment of energy used in agriculture; a categorization of grain crop production, land suitable for energy crop production, and livestock production in the 201-county TVA region; a summary of technical and economic information on fuel alcohol production; a

discussion of acreages required to produce fuel for benchmark farms in the Tennessee Valley and possible erosion impacts; and a discussion of other pertinent advantages and disadvantages of fuel alcohol production from crops. DOE

N83-27051# Department of Energy, Bartlesville, Okla Energy Technology Center.

DIESEL FUEL OILS, 1982

E. M. SHELTON Nov. 1982 36 p refs
(DE83-006115; DOE/BETC/PPS-82/5) Avail: NTIS HC A03/MF A01

Properties of diesel fuels produced during 1982 were submitted for study an compilation under a cooperative agreement between the Department of Energy (DOE), Bartlesville Energy Technology Center (BETC), Bartlesville, Oklahoma and the American Petroleum Institute (API). Tests of 184 samples of diesel fuel oils from 83 refineries throughout the country were made by 27 petroleum groups according to type of diesel fuel. Each group of analyses is subdivided into five tabulations according to five general regions of the country where the fuels are marketed. Data from 13 laboratory tests on each individual diesel fuel sample are listed and arranged by geographic marketing districts in decreasing order of sales volumes. Charts are included showing trends of averages of certain properties for the four types of diesel fuels for the years 1980 to 1982. Summaries of the results of the 1982 survey, compared with similar data for 1981, are shown in Tables 1 through 4 of the report. A summary of 1-D and 2-D fuels are presented in Tabs 5 and 6 respectively. DOE

N83-27053# Decision Focus, Inc., Palo Alto, Calif
INTEGRATED FORECASTING MODEL, SYNTHETIC-FUELS STUDY. VOLUME 2: MODEL STRUCTURE AND INPUT DATA
R. A. MARSHALLA Apr 1982 257 p refs Sponsored by EPRI
(DE82-905778, EPRI-EA-2358-VOL-2) Avail: NTIS HC A12/MF A01

The future of a synthetic fuels industry in United States, with particular emphasis on the consequences for the electric power industry, is assessed in this study. The assessment is based on use of the Integrated Forecasting Model (IFM), a technology based integrated system model of the national energy economy. The study was performed under the general direction and advice of a working group composed of several representatives from each of six EPRI divisions. This enabled the study to serve as a transfer vehicle for introducing the IFM as a general technology assessment and R & D planning tool. A series of model scenarios was structured around three key uncertainties bearing on the future of synthetic fuels: synfuels process costs, imported oil prices, and system inertia, and aggregate representation of the effects of institutional and other factors on the maximum rate of market penetration of a new technology once it has become economically attractive. The study findings are summarized. DOE

N83-27054# Midwest Research Inst., Golden, Colo Solar Energy Research Inst.

DISSOCIATED METHANOL TEST RESULTS

J. G. FINEGOLD and J. T. MCKINNON Apr 1982 14 p refs
Presented at the Automotive Technol. Develop. Contractor Coordination Meeting, Dearborn, Mich., 14 Apr. 1982. Biomass to Methanol Workshop, Durango, Colo., 3-5 Mar. 1982. Contractor Semian Rev. Meeting, Burlingame, Calif., 16-18 May 1982.
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-013565; SERI/TP-235-1582; CONF-820445-1; CONF-820324-4, CONF-820541-1) Avail: NTIS HC A02/MF A01

The design and testing of an automotive fuel system that provides hydrogen-rich gases to an internal combustion engine by catalytically cracking, or dissociating, methanol on board the vehicle is described. The vaporization and dissociation of methanol absorb heat from the engine exhaust and increase the lower heating value of the fuel by approximately 22%. In addition, raising the compression ratio and burning with excess air increase the engine thermal efficiency. Engine dynamometer test results with

dissociated methanol demonstrated improvement in brake thermal efficiency compared to gasoline from 30% to 100% depending on engine speed and torque. Lower speeds and torques produce the largest improvements. Maps of exhaust temperature and exhaust heat content are presented. The exhaust temperature is almost always high enough for dissociation to occur, but at lower power outputs, there is only enough exhaust energy for partial dissociation of the methanol. DOE

N83-27057# Office of Technology Assessment, Washington, D.C.

INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS: ALTERNATIVES FOR REDUCING OIL IMPORTS. BACKGROUND PAPER NUMBER 2: SELECTED TECHNICAL AND ECONOMIC COMPARISON OF SYNTHETIC OPTIONS

Oct 1982 257 p refs
(PB83-147363, BACKGROUND-PAPER-2) Avail: NTIS HC A12/MF A01 CSCL 21D

A comparative technical and economic assessment of selected synfuel technologies was studied. It is a component part of a much larger study on energy options. A key purpose of this study is to provide technical and economic comparisons among selected synfuel technologies which, to the extent possible, provides a background and basis which may assist the office of technology assessment (OTA) in its policy deliberations. GRA

N83-27170# Sandia Labs., Albuquerque, N. Mex. Process Research Div.

MASS FLOW MEASUREMENT OF SOLIDS/GAS STREAM USING RADIOMETRIC TECHNIQUES

J. K. LINN and D. G. SAMPLE 1982 18 p refs
Presented at the Symp. on Instr. and Control for Fossil Energy Processes, Houston, Tex., 7 Jun 1982.
(Contract DE-AC04-76DP-00789)
(DE82-017028, SAND-82-0228C, CONF-820612-3) Avail: NTIS HC A02/MF A01

A mass flowmeter utilizing radiometric techniques was designed and built for measuring flows in two phase gas/solids feed streams in coal gasification processes. The instrument combines a radiometric density measurement and a time cross correlation velocity determination into a nonintrusive gas/solids mass flowmeter. Accuracies of 5 to 10% are anticipated for flow with 10% solids fraction and velocities of one to five meters per second. The theory, the relevant radiometric cross sectional background data, and the developed system digital data handling are described. DOE

N83-27215# Oak Ridge National Lab., Tenn
INTERNATIONAL CONFERENCE ON WELDING TECHNOLOGY FOR ENERGY APPLICATIONS

S. A. DAVID, comp. and G. M. SLAUGHTER, comp. Sep 1982 658 p refs
Conf. held in Gatlinburg, Tenn., 16-19 May 1982; sponsored by American Welding Society, ORNL and American Society for Metals Joining Div.
(Contract W-7405-ENG-26)
(DE83-006404; CONF-820544) Avail: NTIS HC A99/MF A01

Topics concerning welding techniques for application to fossil and nuclear energy technology are addressed. Special emphasis is placed on pressure vessels, heat exchangers, tubing, automation, and materials considerations.

04 FUELS AND OTHER SOURCES OF ENERGY

N83-27241# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.

HIGH-TEMPERATURE TURBINE-TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES. DESIGN AND DEVELOPMENT OF A REGENERATIVELY FUEL COOLED HIGH TEMPERATURE GAS TURBINE COMBUSTOR FOR OPERATION ON LOW BTU GAS

Jul. 1982 167 p

(Contract DE-AC01-76ET-10348)

(DE83-007342; CW-WR-76-020.104A) Avail: NTIS HC A08/MF A01

The fuel air requirements for low Btu gas combustors result in a paucity of cooling air which results in low Btu gas fueled air cooled combustor designs with annular configurations with complex flow path schemes to maximize cooling efficiency. If the low Btu gas can be utilized as a cooling system medium before it is combusted, conventional multiple can arrangements with simple convection cooled liner can be developed. The design, fabrication and test of a full scale industrial gas turbine burner can with convective cooling of the liner wall by 150 Btu/scf gaseous fuel typical of air blown gasification of coal is described. The 10-in. internal diameter combustor can was successfully operated up to 6 atmospheres pressure, burning 150 Btu/scf gaseous fuel up to 30000F average exit temperature. The fuel cooling effect and combustor exit emissions levels are determined for gas supply temperatures of 150 and 3750 F. The NO/sub x/ emissions levels at the nominal 30000 F combustor exit temperature was substantially below the EPA regulatory level of 75 ppm when adjusted for pressure level effect of 15 atm and 15% oxygen

DOE

N83-27245# Aerospace Corp., El Segundo, Calif Energy Conservation Directorate

ASSESSMENT OF WATER ADDITION TO SPARK IGNITION ENGINES

R. R. COVEY and J. J. DONNELLY, JR. Sep. 1982 53 p refs (Contract DE-AI01-82CS-50286; F04701-81-C-0082)

(DE83-006013; DOE/CS-50286/3) Avail: NTIS HC A04/MF A01

This report presents an assessment of water addition to spark ignition engines based on data available in the open literature and on information obtained through communication with university, industrial, and government personnel. Water addition techniques addressed are (1) manifold injection or carburetion of water-gasoline emulsions, (2) separate induction of water and gasoline, (3) direct cylinder injection of water, (4) manifold water-vapor induction, and (5) water injection into the air intake. Test results show that water addition typically decreases vehicle fuel economy and NO/sub x/ emissions, increases HC emissions, and suppresses combustion knock. When accompanied by an engine compression ratio increase and/or advanced spark timing, limited data show that water addition can result in a moderate fuel economy increase at the expense of increased emissions. Unresolved problem areas include phase instability and cost of water-gasoline emulsions, engine corrosion, engine lubricant contamination and deposits, and the need for a freezing point depressant. Water-vapor induction devices (often misnamed as vapor injectors) available in the commercial automotive aftermarket have little or no effect on fuel economy.

DOE

N83-27310*# Earth Satellite Corp., Chevy Chase, Md. **STUDY OF LANDSAT-D THEMATIC MAPPER PERFORMANCE AS APPLIED TO HYDROCARBON EXPLORATION Quarterly Progress Report, 7 Jan. - 7 Apr. 1983**

J. R. EVERETT, Principal Investigator 7 Apr. 1983 31 p ERTS

(Contract NAS5-27384)

(E83-10325; NASA-CR-170383, NAS 1 26:170383, QPR-2) Avail: NTIS HC A03/MF A01 CSDL 14B

Improved delineation of known oil and gas fields in southern Ontario and a spectacularly high amount of structural information on the Owl Creek, Wyoming scene were obtained from analysis of TM data. The use of hue, saturation, and value image processing

techniques on a Death Valley, California scene permitted direct comparison of TM processed imagery with existing 1:250,000 scale geological maps of the area and revealed small outcrops of Tertiary volcanic material overlying Paleozoic sections. Analysis of TM data over Lawton, Oklahoma suggests that the reducing chemical environment associated with hydrocarbon seepage change ferric iron to soluble ferrous iron, allowing it to be leached. Results of the band selection algorithm show a surprising consistency, with the 1,4,5 combination selected as optimal in most cases A.R.H.

N83-27333# Marathon Oil Co., Bridgeport, Ill.

COMMERCIAL SCALE DEMONSTRATION: ENHANCED OIL RECOVERY BY MICELLAR-POLYMER FLOOD Annual Report, Oct. 1980 - Sep. 1981

J. C. HOWELL Bartlesville, Okla DOE May 1982 131 p

(Contract DE-AC03-78ET-13077)

(DE82-013574; DOE/ET-13077/63) Avail: NTIS HC A07/MF A01

This commercial scale test, known as the M-1 Project, is located in Crawford County, Illinois. It encompasses 407 acres of Robinson sand reservoir and covers portions of several waterflood projects that were approaching economic limit. The project includes 248 acres developed on a 2.5-acre five-spot pattern and 159 acres developed on a 5.0-acre five-spot pattern. Development work commenced in late 1974 and has previously been reported. Micellar solution (slug) injection was initiated on February 10, 1977, and is now completed. After 10% of a pore volume of micellar slug was injected, injection of 11% pore volume of Dow 700 Pusher polymer was conducted at a concentration of 1156 ppm. At the end of this reporting period, 625 ppm polymer was being injected into the 2.5-acre pattern and 800 ppm polymer was being injected into the 5.0-acre pattern. The oil cut of the 2.5-acre pattern has decreased from 11.0% in September 1980, to 7.9% in September 1981.

DOE

N83-27334# Department of Energy, Dallas, Tex. Energy Information Administration.

LIBYA, ALGERIA AND EGYPT: CRUDE OIL POTENTIAL FROM KNOWN DEPOSITS

W. D. DIETZMAN, N. R. RAFIDI, and T. A. ROSS Apr 1982 122 p refs

(DE82-018578; DOE/EIA-0338) Avail: NTIS HC A06/MF A01

An analysis is presented of the discovered crude oil resources, reserves, and estimated annual production from known fields of the Republics of Libya, Algeria, and Egypt. Proved reserves are defined as the remaining producible oil as of a specified date under operating practice in effect at that time and include estimated recoverable oil in undrilled portions of a given structure or structures. Also included in the proved reserve category are the estimated indicated additional volumes of recoverable oil from the entire oil reservoir where fluid injection programs have been started in a portion, or portions, of the reservoir. The indicated additional reserves (probable reserves) reported herein are the volumes of crude oil that might be obtained with the installation of secondary recovery or pressure maintenance operations in reservoirs where none have been previously installed.

DOE

N83-27337# Occidental Research Corp., Irvine, Calif

METHANE RECOVERY FROM HORIZONTAL HOLES IN ADVANCE OF MINING Final Report

B. R. POTHINI Mar. 1982 107 p refs

(Contract DE-AC21-81MC-16372)

(DE82-017673; DOE/MC-16372/56) Avail: NTIS HC A06/MF A01

This methane drainage report covers work performed for the US Department of Energy under Contract DE-AC21-81MC16373 by Occidental Research Corporation during the period January 1, 1981 through March 31, 1982. The primary objective of the production drilling was to drain sufficient quantities of gas from the coal bed in advance of mining for utilization in the coal driven at the Virginia Pochahontas Division No. 5 Mine. During the reporting period a total of 10,367 feet of production drilling was completed compared to the targeted aggregate depth of 5000

feet. In addition, exploration drilling was conducted in two mines totaling to 3750 feet. The production holes have drained 188 MMCF of gas during this period. Since inception of the methane drainage program a grand total of 23,000 feet of horizontal holes have been drilled and approximately 673 MMCF of commercial quality gas has been found. Daily gas production at the end of the period was 1.5 MCDF. DOE

**N83-27338# Kansas Univ., Lawrence.
ASSESSMENT OF THE GEOTHERMAL RESOURCES OF KANSAS**

Jun. 1982 65 p
(Contract DE-AS07-79ET-27204)
(DE83-003216, DOE/ET-27204/T1-V2-APP-SECT-5) Avail. NTIS HC A04/MF A01
Thermal data for some deep wells in Kansas are given. DOE

**N83-27356# Purdue Univ., Lafayette, Ind. Combustion Lab
KINETIC MECHANISM FOR FUEL-NITROGEN CONVERSION IN LEAN TO RICH FLAMES**

R. C. PETERSON and N. M. LAURENDEAU 1982 546 p refs
Presented at the Spring Tech. Meeting of the Central States Section of the Combust. Inst., Columbus, Ohio, 22-23 Mar 1982
(DE82-905467; CONF-830320, CSS/CI-82-15) Avail. NTIS HC A23/MF A01

The 1982 Spring Technical Meeting of Central States Section of the Combustion Institute was held on March 22-23, 1982, at The Ohio State University, Columbus, OH. The title of the Symposium was The Use of High-Sulfur Coal: Combustion, Gasification, and Control of Emissions (notably SO₂). There are some particularly good papers on the air pollution abatement of nitrogen oxides. Twenty-two papers have been entered individually into EDB and ERA; two papers (Nos. 11 and 17) were processed earlier. DOE

**N83-27373# Houston Lighting and Power Co., Tex.
UTILITY GEOTHERMAL PLANS, TEXAS AND LOUISIANA**

J. R. RIDGWAY, JR. In Atlas Corp. Proc. of the 6th Ann. Geothermal Conf. and Workshop 3 p Dec. 1982
Avail: NTIS HC A13/MF A01

The best opportunity for geothermal energy recovery seems to be the geopressed aquifer system which extends under the Louisiana and Texas Gulf Coast. To learn more of these formations and their contents which have been responsible for most of the blowouts in petroleum wells while drilling to 12,000 feet and greater depths, design wells are used. Design wells are wells which are designed and drilled specifically for the purpose of testing the geopressed aquifers. The status of four design wells, are reported. S L

**N83-27374# California Dept. of Water Resources, Sacramento
GEOTHERMAL ENERGY AND THE STATE WATER PROJECT**

H. STRUCKMEYER and B. JOHNSON In Atlas Corp. Proc. of the 6th Ann. Geothermal Conf. and Workshop 5 p Dec. 1982
Avail: NTIS HC A13/MF A01

The geothermal program is a small but very important part of the overall energy program. Through actual efforts in developing generating facilities, the true costs, problems and values are learned. The overall position in the geothermal arena is determined. Geothermal energy development activities are discussed. S L

N83-27385# Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.

THE FEASIBILITY OF BIOGAS PRODUCTION ON FARMS

W. J. JEWELL, B. A. ADAMS, B. P. ECKSTROM, K. J. FANFONI, R. M. KABRICK, and D. F. SHERMAN Jan 1982 178 p refs
(Contract DE-AC02-77CH-00178; DE-AC02-76ET-20051)
(DE83-007385; SERI/PR-9038-1-T1; XB-0-9038-1-10) Avail: NTIS HC A09/MF A01

Biogas technology is reviewed. The following topics are discussed: (1) the potentials and limitations of anaerobic digestion; (2) on site energy generation; (3) relationship of demand to supply; (4) economics of farm scale biogas production, (5) design

considerations of the biogas production system; (6) gas utilization, (7) safety guidelines and regulations; and (8) operation, maintenance, and diagnostics of small methane generation systems. GRA

N83-27388# Carpenter Environmental Associates, Inc., Northvale, N.J.

EXPLORATOR STUDY OF PLASMA ARC JET SHALE CONVERSION

Mar. 1982 144 p
(Contract DE-AC01-80ER-10784)
(DE82-009090, DOE/NBM-2009090) Avail. NTIS HC A07/MF A01

This report discusses the results of our exploratory study, dealing with the use of plasma arc jets in shale conversion. Laboratory experiments are discussed and preliminary data are presented. Mini net energy analysis and environmental impact analysis are presented within the framework of the very limited amount of information available on the subject. DOE

**N83-27389# Sandia Labs., Albuquerque, N. Mex.
PROJECT DEEP STEAM**

B. W. MARSHALL 1982 9 p Presented at the Ann. Heavy Oil Slush EOR Contractors Conf., San Francisco, 27 Jul. 1982
(Contract DE-AC04-76DP-00789)
(DE82-016394; CONF-820712-2) Avail. NTIS HC A02/MF A01

Development of technology for thermally efficient downhole delivery of surface generated steam and for downhole steam generators are the major elements of Project DEEP STEAM. Specific activities include development of advanced concept thermal packers, evaluation of the thermal performance of insulated tubing designs in a test tower and in a field environment, and development of downhole steam generator concepts. Field tests were performed in both technology areas and the results and status are presented. DOE

**N83-27391# Radian Corp., Austin, Tex.
SIMULATED HEAT-EXCHANGER TUBES: DOE GEOTHERMAL TEST FACILITY, EAST MESA, CALIFORNIA**

P. F. ELLIS, II and D. M. ANLIKER Nov 1982 19 p refs
(Contract DE-AC03-81SF-11503)
(DE83-007415, DOE/SF-11503/T2, DCN-82-212-011-42) Avail. NTIS HC A02/MF A01

A 103 hr corrosion test was performed of two geothermal heat exchanger materials, Allegheny-Ludlum Alloy 29-4 and Alloy 29-4C. Coupons of the two metals were exposed under conditions simulating flow in a geothermal heat exchanger tube. Continuous flow and cyclic exposure tests were made. No signs of localized corrosion were observed in either the base metal, tube weld seam, or heat affected zone. Most coupons show statistically insignificant weight change. A corrosion rate of less than 0.5 mil/yr is indicated. No significant difference in the performance of the two alloys is reported. DOE

N83-27395# Sandia Labs., Albuquerque, N. Mex. Geo Energy Technology Dept.

GEO ENERGY RESEARCH AND DEVELOPMENT: TECHNOLOGY TRANSFER UPDATE

R. K. TRAEGER and V. I. DUGAN Jan. 1983 47 p refs
(Contract DE-AC04-76DP-00789)
(DE83-007225; SAND-83-0018) Avail: NTIS HC A03/MF A01

Sandia Geo Energy Programs in geothermal, coal, oil and gas, and synfuel technologies have been effective in transferring research concepts to applications in private industry. This report updates the previous summary (SAND82-0211, March 1982) to include recent technology transfers and to reflect recent changes in philosophy on technology transfer. Over 40 items transferred to industry have been identified in the areas of Hardware, Risk Removal and Understanding. Successful transfer is due largely to personal interactions between Sandia engineers and the technical staffs of private industry. DOE

04 FUELS AND OTHER SOURCES OF ENERGY

N83-27401# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF A PRESSURIZED FLUIDIZED-BED BIOMASS GASIFIER TO PRODUCE SUBSTITUTE FUELS
S. P. BABU, M. ONISCHAK, and G. KOSOWSKI 1982 12 p refs Presented at the Biomass to Methanol Spec. Workshop, Durango, Colo., 3-5 Mar. 1982
(Contract DE-AC02-80CS-83004)
(DE82-013265; CONF-820324-2) Avail: NTIS HC A02/MF A01

The Institute of Gas Technology (IGT) is conducting a program to convert forest and crop residues to substitute fuel in a pressurized fluidized-bed biomass gasifier. The process is designed for operation at pressures up to 2.17 MPa (315 psia) and temperatures up to 1255 K (1800 F). Various goals for synthesis or fuel gas processes are being pursued to develop an efficient process. Some of these goals are to maximize the throughput, the amount, and the quality of the gas, while minimizing both the amount of the feedstock preparation needed and the formation of condensable compounds that require by-product disposal and process wastewater treatment. The process development results obtained from fluidization biomass devolatilization, and char gasification studies were used to design a 30/5-cm (12-inch) ID adiabatic fluidized-bed gasification process development unit (PDU), capable of handling up to 455 kg (1000 lb) of biomass per hour

DOE

N83-27404# Oak Ridge National Lab., Tenn Engineering Technology Div.
INTERNATIONAL ENERGY TECHNOLOGY ASSESSMENT: ATMOSPHERIC FLUIDIZED-BED COMBUSTION
R. P. KRISHNAN and K. O. JOHNSON Apr. 1982 399 p
(Contract W-7405-ENG-26)
(DE82-012430, ORNL/TM-8033) Avail: NTIS HC A17/MF A01

A survey was made of atmospheric fluidized bed combustion (AFBC) research and development and commercial activities in foreign countries. These activities indicate a broad interest in the process largely because of its flexibility in burning a wide range of coals and low grade fuels. The conclusion is made that AFBC is a viable system and is in the process of being confirmed on a commercial scale for industrial heat and power generation. A number of organizations in the United States and western Europe are offering fluidized bed package boilers, with some form of commercial guarantees. The major uncertainties of the process lie in the areas of coal and sorbent handling systems, availability of reliable construction materials; the system's ability to meet varying load demands, reduced sorbent requirements; and improved carbon utilization. Research and development programs in these areas are being pursued.

DOE

N83-27405# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
RESEARCH STRATEGY TO PERMIT GREATER UTILIZATION OF DOMESTIC FOSSIL ENERGY RESOURCES
T. E. OHARE Mar. 1982 17 p
(Contract DE-AC02-76CH-00016)
(DE82-018339; BNL-51554) Avail: NTIS HC A02/MF A01

Discussed are 3 approaches taken for developing fossil energy resources: carbon monoxide and synthesis gas; coal-water slurries; and control of ashes. Carbon monoxide and synthesis gas serve as clean multipurpose feedstocks for use as a source of future industrial raw material and fuels. Coal-water slurries are a poor man's synfuel. It makes practical the use of coal in oil-fired utility boilers, industrial heaters, and furnaces. Ash is a deterrent to the use of coal because it is burdensome to dispose of and has serious effects on equipment, the environment, and man. An objective of coal cleaning should be ash removal as well as sulfur.

DOE

N83-27406# Mitre Corp., McLean, Va. METREK Div
FURTHER STUDIES ON DEVELOPING TECHNOLOGY FOR INDIRECT LIQUEFACTION
D. GRAY, M. B. NEUWORTH, and G. TOMLINSON Mar. 1982 126 p refs
(Contract DE-AC01-77ET-10280)
(DE82-017677, DOE/ET-10280/T3, MTR-82W32) Avail: NTIS HC A07/MF A01

Our investigations have resulted in the conclusion that fluidized gasifiers, such as Westinghouse or entrained flow gasifiers such as Texaco and Shell-Koppers offer significant advantages over the BGC Lurgi gasifier when Illinois No. 6 coal is employed as the feedstock. Dry-ash Lurgi gasification has additional disadvantages which appear to make it unsuitable for applications with mildly caking coal such as Illinois No. 6. The results of our analyses of Illinois No. 6 coal do not alter our prior conclusions regarding the use of advanced gasification systems for indirect liquefaction. BGC/Lurgi, Westinghouse, Texaco and Shell-Koppers gasifiers offer significant advantages over dry-ash Lurgi and should be given detailed consideration for a US liquefaction facility. The final decision will probably be driven by the relative state of development at the time a decision is required, process license and guarantees which could be negotiated, the market value of an SNG co-product, and the specific characteristics of the coal feedstock to be used.

N83-27426# Meridian Corp., Falls Church, Va
BIOMASS-ENERGY-TECHNOLOGY PROGRAM SUMMARY
Jun. 1982 131 p refs
(Contract DE-AC01-80ET-20647)
(DE82-018926; DOE/ET-20647/1) Avail: NTIS HC A07/MF A01

An account is given of the ongoing research, development, and demonstration efforts of the Biomass Energy Technology program. Descriptions are given for each of the program projects funded and/or in existence during Fiscal Year 1981, reflecting their status as of September 30, 1981. The summaries are grouped as follows: feedstock production, conversion systems, market development, and general support and analysis

DOE

N83-27432# New Mexico Univ., Albuquerque Energy Research and Development Inst.
SMALL HYDROELECTRIC POWER PLANT FOR AZTEC, NEW MEXICO Final Report, 1 Dec. 1980 - 28 Feb. 1982
E. W. FREY May 1982 158 p
(DE82-903957, NMERI-EN-12) Avail: NTIS HC A08/MF A01

Preliminary engineering results and the outcome of other specific studies associated with the establishment of a hydroelectric power plant at Aztec, New Mexico, are presented, with particular emphasis on estimated costs of construction and long term operation. Four alternative levels of effort were evaluated. Recommendations, based primarily on cost effectiveness, are presented along with material useful as a basis for a possible follow on Phase II study. At least three levels of effort appear economically attractive alternatives for the city to pursue

DOE

N83-27444# Pittsburgh Univ., Pa.
ADDITION OF DEVOLATILIZATION EQUATIONS TO SYNTHANE COMPUTERIZED MATHEMATICAL MODEL Final Report, 15 Sep. 1978 - 14 Sep. 1979
J. T. COBB, JR. and C. K. WU Jan. 1983 133 p refs
(Contract DE-AS22-78ET-00277)
(DE83-006243, DOE/ET-00277/T1) Avail: NTIS HC A07/MF A01

A mathematical model, based on IGT (Institute of Gas Technology) kinetics, to simulate the gasification of coal in the SYNTHANE gasifiers was developed. By using this program the PETC has analyzed some 35 runs in the SYNTHANE PDU and 14 runs in the SYNTHANE Pilot Plant for noncaking western coal. The amount of devolatilization of coal particles falling through the carbonizer of both the PDU and Pilot Plant during these 49 runs were predicted using calculated particle temperature profiles along the carbonizer. In making these predictions, the effect of changes in the three parameters of kinetics model were analyzed.

DOE

N83-27450# California Univ., Livermore. Lawrence Livermore Lab.

LABORATORY TESTS AT ELEVATED PRESSURES OF A SILANE IGNITER SYSTEM FOR IN-SITU COAL GASIFICATION
C. B. THORSNESS, D. F. SKINNER, and D. B. FIELDS 15 Nov. 1982 32 p refs

(Contract W-7405-ENG-48)

(DE83-007217; UCRL-53361) Avail: NTIS HC A03/MF A01

A silane/propane igniter and burner system was used for the first time in underground coal gasification experiments in the Tono Basin of Washington in the winter of 1981-1982. With this system, a small diameter tube (1/2 in) is inserted in the hole to the point where ignition is desired; the tube is purged with nitrogen to drive out the air, and a change of the pyrophoric gas silane (SiH_4) is forced through it when the silane reaches the end of the tube, it bursts into flame upon exposure to the air; a fuel gas such as propane is sent through the tube behind the silane to sustain the burn for as long as desired. The system was designed both for igniting coal and for burning through steel pipe from the inside to provide a new outlet from the pipe. The optimum operating procedure for the igniter system was demonstrated and the system was tested under elevated pressures such as may be encountered in underground coal gasification. It is found that the essential steps in the operating procedure are to turn off the flow briefly after the silane reaches the end of the tube, then slowly begin the flow of fuel behind the silane. Both propane and methane were tested as fuels, propane was found to be preferable for pressures up to about 70 psia (5 atm), and methane for higher pressures. The upper pressure limit for silane ignition was found to be about 230 psia (16 atm). DOE

N83-27473# Louisiana State Univ., Baton Rouge

TECHNICAL SUPPORT FOR GEOPRESSURED-GEOTHERMAL-WELL ACTIVITIES IN LOUISIANA Annual Report, 1 Nov. 1980 - 31 Oct. 1981

D. G. BEBOUT, Z. BASSIOUNI, D. R. CARVER, C. G. GROAT, R. H. PILGER, JR., and F. M. WRIGHTON 31 Mar 1982 321 p refs

(Contract DE-AC08-81NV-10174)

(DE83-005297; DOE/NV-10174/1) Avail: NTIS HC A14/MF A01

Regional assessment of the volume and distribution of potential sandstone reservoirs from each formation was made from data from the 15 dip cross sections and 1 strike cross section. Reservoir bulk volume was determined by constructing a sandstone isopach map. The contour lines of net sandstone were planimetered, and the units obtained were converted to acres. A plot of the contour values vs acres was used to determine the bulk volume in acre feet, which then was converted to cubic miles. Total in place solution methane resources of 371 TCF was estimated to be present in the Wilcox, Frio, and Miocene of onshore Louisiana. DOE

N83-27495# Pacific Northwest Lab., Richland, Wash.
OIL SHALE FUGITIVE AIR EMISSIONS

In its Pacific Northwest Lab. Rept. to the DOE Office of Energy Res. p 37-40 Feb. 1983 refs

Avail: NTIS HC A04/MF A01

Evaluating fugitive airborne particulate and gaseous emissions from the present and future oil shale activities; investigating emissions from mining, transportation, material handling, crushing, retorting, and spent shale disposal sites; and identifying and classifying pollutants such as carbon monoxide, hydrogen sulfide, oxides of nitrogen, ozone, sulfur dioxide, hydrocarbons, and suspended particles are discussed. DOE

N83-27525# Los Alamos Scientific Lab., N. Mex.

CANDIDATE SITES FOR FUTURE HOT-DRY-ROCK DEVELOPMENT IN THE UNITED STATES

F. GOFF and E. R. DECKER Dec 1982 40 p refs

(Contract W-7405-ENG-36)

(DE83-007103; LA-9625-HDR) Avail: NTIS HC A03/MF A01

Generalized geologic and other data are tabulated for 24 potential hot dry rock (HDR) sites in the contiguous United States. The data show that HDR resources occur in many geologic and tectonic settings. Potential reservoir rocks at each prospect are described and each system is categorized according to inferred heat sources. The Fenton Hill area in New Mexico is discussed in detail because this region may be considered ideal for HDR development. Three other prospectively valuable localities are described: The Geysers-Clear lake region in California, the Roosevelt Hot Springs area in Utah, and the White Mountains region in New Hampshire. These areas are singled out to illustrate the roles of significantly different geology and geophysics, reservoir rocks, and reservoir heat contents in possible HDR developments. DOE

N83-27811# Naval Postgraduate School, Monterey, Calif.

INSTRUMENTAL PHOTON ACTIVATION ANALYSIS USING THE LINEAR ACCELERATOR AT THE NAVAL POSTGRADUATE SCHOOL M.S. Thesis

W. A. FISHER Oct. 1982 108 p refs

(AD-A125003) Avail: NTIS HC A06/MF A01 CSCL 07D

Charcoal, charcoal residue, potting soil, aluminum foil, bismuth germanate, and petroleum samples have been investigated using instrumental photon activation analysis (i.e., no radiochemistry). The major and minor elements routinely observed by this nondestructive method were: C, C1, Ca, Fe, Mg, Si, and K. A comprehensive review of the principles of IPAA was also included in the study. The principles were applied to a theoretical analysis of an oil sample in which the trace element concentrations were known. It was concluded that IPAA is a highly sensitive technique which could be used to fingerprint oils. Author (GRA)

N83-27895# Department of Energy, Bartlesville, Okla. Energy Technology Center

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Report, 1 Oct. 1981 - 30 Sep. 1982

B. E. GAMMON and N. K. SMITH Nov. 1982 21 p refs

(Contract AF-AFOSR-ISSA-82-00012, AF PROJ. 2308)

(AD-A125022; AFOSR-83-0047TR) Avail: NTIS HC A02/MF A01 CSCL 21E

This research program consisted of an integrated and interrelated effort of basic and applied research in chemical thermodynamics and thermochemistry. Knowledge of variation of physical and thermodynamic properties with molecular structure was used to select compounds for study that because of high ring strain or unusual steric effects may have good energy characteristics per unit volume or per unit mass and thus be useful in the synthesis of high energy fuels. These materials were synthesized, and their thermodynamic properties were evaluated. In cooperation with researcher at Wright-Patterson Air Force Base, ramjet fuels currently in use were subjected to careful thermodynamic evaluation by measurements of heat capacity, enthalpy of combustion and vapor pressure. During the last year of this effort, seven kerosene-type fuels produced by British Petroleum and seven jet fuels produced from shale oil were studied. Author (GRA)

N83-28023# Joint Publications Research Service, Arlington, Va.

AEROSPACE PHOTOGRAPHY IN THE SERVICE OF GEOLOGY

V. VOLKOV In its USSR Rept.: Space, No. 21 (JPRS-83430) p 112-116 9 May 1983 Transl. into ENGLISH from Tekhn. i Vooruzheniye (Moscow), no. 4, Apr. 1982 p 2-3

Avail: NTIS HC A07

Among the methods of studying the geological structure of the earth and its mineral and raw material resources, aerospace photography presently occupies one of the leading places. Using sensing equipment installed aboard spacecraft and airplanes

(photographic, photoscanning, television, radiometric etc.), large geological bodies and structures are studied, and their relationships in space analyzed. The information helps to establish the laws of mineral distribution and reveal areas in which new mineral deposits might be discovered. By subjecting high altitude and space photography to geological analysis, information on the structure and composition of not only deposits nears the surface but also rock lying much deeper down are obtained. Author

N83-28110 Illinois Univ., Chicago.

THE GROUP COMBUSTION OF LIQUID FUEL IN LAMINAR SPRAY JET Ph.D. Thesis

H Y KIM 1982 251 p

Avail. Univ. Microfilms Order No DA8225151

The present study examines the global configuration, detailed structure, and combustion characteristics of sprays under various firing conditions represented by various principal parameters including group combustion number, fuel-air mass ratio, Reynolds number, and spray angle. A system of conservation equations of spray flames in an axisymmetric configuration is solved by a finite difference method for n-Butylbenzen (C₁₀H₁₄). An extensive spray sensitivity study reveals remarkable insight into the group flame structure which can be adopted as a basic engineering criteria for spray flame classification. It can be used to develop practical guides for the design of atomizers and burners. Highlights of the study are described in the following. There are three principal spray group combustion modes that may occur independently in a spray burner. These combustion modes are external, internal and critical group combustion modes, according to the relative magnitude of the length of the flame and the spray jet.

Dissert. Abstr

N83-28122# KVB, Inc., Irvine, Calif.

COMBUSTION EVALUATION OF RESIDUAL FUEL OIL FROM TWO-STAGE LIQUEFACTION Final Report

J K. ARAND, L. J. P. CHRISMAN, M. N. MANSOUR, and L. J. MUZIO Feb. 1983 74 p refs

(Contract EPRI PROJ 1412-5)

(DE83-901448, EPRI-AP-2845) Avail: NTIS HC A04/MF A01

A two stage coal liquefaction (TSL) residual fuel oil was tested to evaluate the combustion and emission characteristics of the fuel. Testing was performed with a blend of TSL solids and a coal derived distillate designed to simulate the TSL residual fuel oil. Further tests were conducted with the actual TSL residual fuel oil prepared entirely from products of two stage liquefaction processing. Combustion variables included furnace excess O₂, fuel atomization, burner stoichiometry, combustion air swirl and boiler load. In general, the tests showed that TSL residual fuel oil burns well with flame characteristics similar to those of No. 6 fuel oil. Due to the high nitrogen content of the fuel (approximately 0.9 percent by weight), NO emissions from TSL residual fuel oil under normal combustion (unstaged) were 400 to 500 pp greater than the emission level produced by a conventional No. 6 fuel oil. Staged combustion was effective in reducing NO emissions by up to 60%; however, the reduction in NO emissions was obtained at the expense of doubling the particulate emissions. Modification of atomizer design variables provided a reduction in both particulate and NO emissions. It is suggested that further refinement of the combustion variables may allow the use of this fuel as a replacement for petroleum derived residual fuel oil in utility type applications. DOE

N83-28125# Arrowhead Plastic Engineering, Inc., Muncie, Ind SEPARATION OF ALCOHOL-WATER MIXTURES BY SELECTIVE ADSORPTION Final Technical Report

R. J. DEARBORN 24 Dec. 1982 28 p refs

(Contract DE-FG02-81R-510297)

(DE83-005040; DOE/R5/10297/T2) Avail: NTIS HC A03/MF A01

The plastic waste that is generated during the manufacture of electric storage batteries was utilized in the preparation of new and different resins. This waste is pure polyvinyl chloride and in storage batteries sintered sheets of the polymer are used as cell

separators. The scrap, in the form of thin flakes, can be ground to any particle size range including powder. If the particles are about 30 to 60 mesh they are granular and physically resemble the resins used in adsorption and ion exchange processes. A procedure was developed for the replacement of a portion of the chlorine atoms in the granular polyvinyl chloride with amine nitrogen-containing groups. Reaction conditions were investigated and it was established that low temperatures (80 to 950 C) and rather long reaction times (24 to 72 hours) resulted in minimal degradation of the polyvinyl chloride and replacement of up to one-third of the chlorine atoms with amine groups. In most instances the modified PVC resins contained four to six percent nitrogen. DOE

N83-28126# California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Chemical Engineering.

HOMOGENEOUS HYDROGENATION OF MODEL-COAL COMPOUNDS Ph.D. Thesis

G. A. CREMER, T. VERMEULEN, and R. H. FISH May 1982 114 p refs

(Contract DE-AC03-76SF-00098)

(DE82-017146; LBL-14216) Avail: NTIS HC A06/MF A01

The objectives of this study were twofold to assess the effectiveness of metal carbonyls and (related complexes) as homogeneous hydrogenation catalysts for model coal compounds and to gain fundamental information about low temperature, low pressure coal liquefaction. Since a catalytically active transition metal hydride may form in a number of ways, reaction conditions included various combinations of hydrogen, carbon monoxide, and water (or aqueous base). The effect of the different conditions on catalyst activity and relative reaction rates was investigated and mechanistic interpretations were formulated. DOE

N83-28132# Idaho State Univ., Pocatello Dept. of Geology SOLUBILITY OF METHANE IN WATER UNDER NATURAL CONDITIONS: A LABORATORY STUDY Final Report, 1 Apr. 1978 - 30 Jun. 1982

C. W. BLOUNT and L. C. PRICE Jun. 1982 159 p refs

(Contract DE-AS08-78ET-12145)

(DE82-017680; DOE/ET-12145/1) Avail: NTIS HC A08/MF A01

The solubility of methane in aqueous solutions was determined over a broad range of temperature, pressure and salinities. The effect of dissolved carbon dioxide and ethane on methane solubility was determined at 302 F. Also the solubility of crude oil and water in methane was determined over a broad range of temperatures and pressures. The solubility of methane is raised by increasing pressure and temperature (above about 170 F). There is a solubility minimum near 170 F at constant pressure and salinity. Ionic salts effectively salt methane out of solution at all concentrations investigated. The effect of the addition of small amounts of carbon dioxide or ethane to the gas dissolved in aqueous solutions is to enhance methane solubility compared to solutions without other gases. Higher concentrations of dissolved gases, depending upon the salinity and the gas involved, decrease aqueous methane solubility. DOE

N83-28133# Tennessee Valley Authority, Muscle Shoals, Ala. Office of Natural Resources

CHEMICAL INTERACTIONS IN ISOLATED COAL-FIRED POWER PLANT PLUMES: CONVERSION OF SULFUR DIOXIDE TO SULFATE AEROSOLS. VOLUME 1: PLUME CHEMISTRY STUDIES

J. F. MEAGHER, E. M. BAILEY, and L. STOCKBURGER, III Mar. 1982 152 p refs

(DE82-903161, TVA/ONR/ARP-82/11-VOL-1) Avail: NTIS HC A08/MF A01

Instrumented aircraft were used to determine the rate of oxidation of sulfur dioxide to sulfate aerosols within the dispersing plumes of three coal fired power plants. Rate measurements were made during each season under a wide variety of meteorological conditions. Experiments were conducted during daylight and nighttime hours. The effect of particulate loading was examined in studies conducted under reduced electrostatic precipitator

performance. Measurements of primary sulfate and sulfur dioxide were also made. The average oxidation rate during fall and winter was found to be .0003 per hour. During the summer an average rate of 0.012 h⁻¹ was found. A rapid conversion of 0.5 to 1.0% of the emitted sulfur dioxide occurs in the immediate vicinity of the power plant during all seasons. The reduction in electrostatic precipitator performance resulted in a decrease in the average conversion rate from 0013 h to 0008 h. Author

N83-28135# American Cyanamid Co., Stamford, Conn. Chemical Research Div.

DEVELOPMENT OF SIGNIFICANTLY IMPROVED CATALYSTS FOR COAL LIQUEFACTION AND UPGRADING OF COAL EXTRACTS Quarterly Progress Report, 1 Oct. - 31 Dec. 1981
V. T. SINHA, M. BUTENSKY, and D. HYMAN 1982 42 p refs (Contract DE-AC22-81PC-40091)
(DE82-014540; DOE/PC-40091/T1; QPR-1) Avail: NTIS HC A03/MF A01

During 1979-1980, a new generation of very active, long lived catalysts for hydrotreating was discovered in the Chemical Research Division of the American Cyanamid Company at Stamford. The catalysts were based on a unique substrate prepared in bead form from a rehydratable alumina. Their spherical shape, crush strength, and abrasion resistance seem ideally suited for use in fluidized bed reactors such as the three (or four) phase fluidized bed reactors used in the H-Oil and the H-Coal processes developed by Hydrocarbon Research, Incorporated. Further, their internal pore structure is almost infinitely controllable, and pore size distributions which would be active for the hydroliquefaction and demetallation reactions but resistant to poisoning and deactivation reactions can be produced if identified. DOE

N83-28136# State Univ. of New York at Buffalo, Amherst.
CATALYTIC COAL LIQUEFACTION Quarterly Report, Apr. - Jun. 1982

S. W. WELLER 1982 19 p refs
(Contract DE-FG22-81PC-40781)
(DE82-019047; DOE/PC-40781/T3; FE-2013-20) Avail: NTIS HC A02/MF A01

Coal liquefaction experiments were carried out in a stirred autoclave under nitrogen. Tetralin was employed as solvent, and the catalyst, when used, was ammonium paramolybdate (impregnated) or stannous chloride (powdered). Production of pentane soluble oil was higher in the runs with catalysts, but the net hydrogen transfer from tetralin to coal was less when catalyst was used. Coal and powdered stannous chloride exhibited a marked synergistic effect on the dehydrogenation of tetralin. A free radical mechanism was suggested to explain this effect, and model experiments with bibenzyl (but no coal) gave results that were consistent with this mechanism. An apparent synergistic effect of coal and impregnated ammonium paramolybdate was shown to be attributable simply to improved distribution (higher surface area) of the impregnated catalyst. DOE

N83-28138# Brigham Young Univ., Provo, Utah. Lab. for Combustion Research.

BASIC COMBUSTION AND POLLUTANT-FORMATION PROCESSES FOR PULVERIZED FUELS Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1982

G. J. GERMANE and L. D. SMOOT Jul. 1982 42 p refs
(Contract DE-FG22-80PC-30306)
(DE82-019054; DOE/PC-30306/T7; QTPR-7) Avail: NTIS HC A03/MF A01

This contract study of basic combustion and pollutant formation processes for pulverized solid fossil fuels includes coal-water mixtures (CWM) and coal chars derived from pyrolysis, liquefaction or gasification processes. Contract work also includes adaptation of computer code techniques to the combustion of these fossil fuels. Highlights for this quarter are: the CWM reactor facility neared completion for initial tests with a methane flame; physical characterization analyses of chars are largely complete, a modified ASTM method for the proximate analysis of coals was used on the Tosco, FMC and Occidental chars with results that correlate

well with other chars; adequate quantities of five chars have been obtained in anticipation of combustor testing; a review was made to identify char oxidation and gasification models for potential implementation into the overall PCGC-2 model; several candidate models were identified from which one or two approaches will be considered. DOE

N83-28139# Physical Sciences, Inc., Woburn, Mass.

EFFECTS OF PREIGNITION ON PULVERIZED COAL COMBUSTION Quarterly Report, 1 Jan. - 31 Mar. 1982

G. A. SIMONS, G. KOTHANDARAMAN, S. P. SCHERTZER, and M. J. PALM 1982 37 p refs
(Contract DE-AC22-80PC-30293)
(DE82-013956; DOE/PC-30293/6; PSI-TR-322; QR-6) Avail: NTIS HC A03/MF A01

Pore structure optimization is complete as reported predicting that high reactivity chars require high porosities and a higher concentration of large pores. The dependence of these quantities on heating rate and final temperature is illustrated. The data obtained for Texas Lignite suggest that porosity (hence reactivity) is strongly dependent on the final pyrolysis temperature with the maximum porosity occurring at 1300 K. The data also indicate that to a lesser extent, the heating rate affects pore structure. Higher heating rates increase the relative number of large pores and thus enhance reactivity by a factor of two. Hence, the optimum pore structure for char reactivity is obtained by preparing char at 1300 K and high heating rates (1000 K/s). Such chars are four times as reactive as chars prepared at 2000 K and 1 to 10 K/s. The theory of pore evolution was completed last quarter. Potential mechanisms of pore evolution were identified and described. DOE

N83-28140# University of Western Michigan, Kalamazoo Dept. of Chemistry.

FUNDAMENTAL OF NITRIC OXIDE FORMATION IN FOSSIL FUEL COMBUSTION Quarterly Progress Report, 20 Dec. 1981 - 28 Mar. 1982

T. HOUSER and M. E. MCCARVILLE Jun. 1982 14 p refs
(Contract DE-FG22-81PC-40805)
(DE82-019044; DOE/PC-40805/2; QPR-2) Avail: NTIS HC A02/MF A01

Experiments to examine the oxidation of HCN in the presence of several fuel additives, using an atmospheric pressure flow system were continued in order to determine the mechanism of NO formation from fuel nitrogen oxidation. Modifications of the flow system were made so that direct sampling of the reactor effluent for gas chromatographic analysis is possible. A series bypass arrangement of the two columns, molecular sieve 5A and porous polymer C 101, was fabricated for more accurate analysis of the light gases, N₂, O₂, CO, CO₂ and N₂O. In addition, several experiments were made with a plug flow, U tube reactor as well as the stirred flow reactor. At fuel rich conditions significant NO yields were obtained when CO was the fuel additive, even at equivalence ratios of 2 and above. However, higher temperatures were necessary for these yields at the higher ratios. DOE

N83-28147# General Electric Co., Schenectady, N. Y. Corporate Research and Development.

H₂S REMOVAL FROM COAL GAS AT MID TEMPERATURE

B. M. KIM, S. G. KIMURA, and J. A. SCHULTZ 1982 36 p refs
Presented at the AIChE Spring Natl Meeting, Anaheim, Calif., 7-10 Jun. 1982
(Contract DE-AC01-80ET-15288)

(DE82-015161; CONF-820610-5) Avail: NTIS HC A03/MF A01

In certain coal gasification processes, the capability to scrub H₂S from coal gas at quench/particulate scrubbing temperatures, typically 150 C to 200 C, would substantially reduce gas cleanup equipment costs, complexity and condensate handling requirements. Candidate absorbents were identified and evaluated. Those absorbents and their performance under realistic operating conditions with simulated coal gas are discussed. The benefits of midtemperature H₂S scrubbing are summarized as follows up to 60% reduction in cleanup system capital cost and components;

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substantially reduced process and controls complexity, opportunity for scrubbing of sulfur compounds and NH₃ in the same location, and elimination of the need for condensate handling and recycle, and potential emissions resulting from these operations. Based on the results obtained and the relative advantages over other processes, the direct oxidation process using stable inorganic catalysts appears to be most promising. DOE

N83-28149# AeroChem Research Labs., Inc., Princeton, N J
RATE COEFFICIENTS OF COMBUSTION/FUEL CONVERSION REACTIONS BY HIGH-TEMPERATURE PHOTOCHEMISTRY
Progress Report, 1 Jul. 1981 - 30 Jun. 1982

W. FELDER and S. MADRONICH Jun. 1982 11 p refs
(Contract DE-AC02-77ER-04169)
(DE82-018823, DOE/ER-04169/7; COO-4169-7) Avail: NTIS
HC A02/MF A01

Reliable kinetic data on isolated, elementary combustion reactions spanning a broad temperature range are required for modeling and scaling studies aimed at improving the performance of, and reducing the pollutant formation from, fossil-fuel burning devices. Such data are generally not available. In the present work a new technique, High Temperature Photochemistry, was developed to provide such data. It combines the technology of the High-Temperature Fast-Flow Reactors developed to study kinetics of metal atom/oxide reactions in the 300 to 1900 K range with the flash photolysis technique, which although used widely for study of such combustion reactions, has previously been limited to studies at or near room temperature. Attempts to produce and detect CH₃ radicals to perform kinetic studies of their oxidation by O₂ and O atoms are discussed. Apparatus modifications and improvements have been made which greatly simplify obtaining data on OH reactions. DOE

N83-28150# Georgia Inst of Tech., Atlanta
DEVELOPMENT OF COAL-BURNING PULSATING COMBUSTOR FOR POWER GENERATION Annual Report

B. T. ZINN, N. MILLER, J. A. CARVALHO, JR., and M. R. WANG
May 1982 35 p refs
(Contract DE-AC22-79ER-10068)
(DE82-019138; DOE/ER-10068/T1) Avail: NTIS HC A03/MF
A01

The burning of coal in a pulsating mode of combustion in a combustor whose design is based upon the Rijke tube principles was investigated. The combustor consists of a vertical tube opened at both ends with a fuel burning bed located in the middle of its lower half. In this configuration, the heat released by the combustion process spontaneously excites the fundamental, longitudinal acoustic mode of the tube. The combustor constructed under this program burns coal stably and continuously under either the self aspirating or the forced flow modes of operation. In the latter case, maximum amplitudes occur near stoichiometric air/fuel ratio operation, indicating that systems utilizing the developed combustor or a similar version should possess high thermal efficiencies. Additionally, it was verified that pulsating operating is possible for a variety of air/fuel ratios, including fuel rich conditions, which suggests that the developed combustor be used as a coal gasifier. DOE

N83-28151# Georgia Inst of Tech., Atlanta School of Aerospace Engineering

DEVELOPMENT OF COAL-BURNING PULSATING COMBUSTOR FOR POWER GENERATION

B. T. ZINN, N. MILLER, J. A. CARVALHO, JR., and M. R. WANG
May 1982 36 p refs
(Contract DE-AC22-79ER-10068)
(DE82-018732, DOE/ER-10066/T2) Avail: NTIS HC A03/MF
A01

Research conducted under this program consisted of an investigation of the burning of coal in a pulsating mode of combustion in a combustor whose design is based upon the Rijke tube principles. The combustor consists of a vertical tube opened at both ends with a fuel burning bed located in the middle of its lower half. In this configuration, the heat released by the combustion

process spontaneously excites the fundamental, longitudinal acoustic mode of the tube. This study demonstrated that the combustor constructed can burn coal stably and continuously under either the self aspirating or the forced flow modes of operation. In the latter case, maximum amplitudes occur near stoichiometric air/fuel ratio operation, indicating that systems utilizing the developed combustor or a similar version should possess high thermal efficiencies. Additionally, it was verified that pulsating operation is possible for a variety of air/fuel ratios, including fuel rich conditions, which suggests that the developed combustor could be used as a coal gasifier. DOE

N83-28160# Washington State Univ., Pullman. Nuclear Radiation Center

SOLVENT-REFINED-COAL (SRC) PROCESS: TRACE ELEMENTS. VOLUME 3: PILOT PLANT DEVELOPMENT WORK. PART 6: THE FATE OF TRACE ELEMENTS IN THE SRC PROCESS Final Research and Development Report

R. H. FILBY, C. A. GRIMM, V. EKAMBARAM, and M. L. HUNT
Apr. 1982 213 p refs Prepared for Pittsburgh and Midway Coal Mining Co., Englewood, Colo.
(Contract DE-AC05-76ET-10104)
(DE82-013523, DOE/ET-10104/52-VOL-3-PT-6; FRDR-53) Avail:
NTIS HC A10/MF A01

The initial efforts concentrated on the development of appropriate analytical procedures for thirty-nine elements. Sensitive neutron activation procedures were developed for Ti, V, Ca, Mg, Al, Cl, Mn, As, Sb, Se, Hg, Br, Co, Ni, Cr, Fe, Na, Rb, Cs, K, Sc, Tb, Eu, Sm, Ce, La, Sr, Ba, Th, Hf, Ta, Ga, Zr, and Cu in feed coals, process solvent, SRC solid and liquid products, mineral residues, filter cake, by-product solvents, process and effluent waters, and by-product sulfur. Atomic absorption spectrophotometric procedures were developed for Pb, Cd, and Be in various plant derived streams and materials including process and effluent waters. The bulk of the trace elements in the coal feed appear to concentrate in the mineral residue with two exceptions; bromine and titanium appear to concentrate in the SRC-1 solid product. High mercury, selenium and arsenic levels in the process water were effectively reduced by the treatment process to essentially natural levels. DOE

N83-28161# Pennsylvania State Univ., University Park Coal Research Section.

RELATION OF COAL CHARACTERISTICS TO LIQUEFACTION BEHAVIOR. PART 1: OBJECTIVES, STRATEGIES AND FIRST SURVEY OF COALS Final Technical Report, Jul. 1976 - Feb. 1981

P. H. GIVEN, W. SPACKMEN, A. DAVIS, H. L. LOVELL, M. M. COLEMAN, and P. C. PAINTER May 1982 43 p refs
(Contract DE-AC22-76ET-10587)
(DE82-016996; DOE/ET-10587/T1-PT-1; FE-2494-FR-1) Avail:
NTIS HC A03/MF A01

Selection of coal feedstocks for liquefaction requires consideration of many characteristics. Moreover, one must also take various aspects of liquefaction behavior into account. To relate the two kinds of information was the principal objective of this study. A set of 104 coal samples was subjected to liquefaction in tetralin at 400 C in tubing bomb reactors. Cluster analysis, provided with liquefaction conversion and values for 14 properties of each coal, partitioned the sample set into three more homogeneous populations. These populations differed chiefly in range of rank, sulfur content and liquefaction conversion. The group including the coals of high sulfur content showed the highest yield of distillable liquid products, while the group of medium sulfur and relatively highrank coals showed the lowest proportion of pre-asphaltenes (i.e., toluene insolubles). The sulfur content of the total liquid product (including excess solvent) increased with the organic sulfur content of the coal used as feedstock. DOE

N83-28162# Delaware Univ., Newark. Dept. of Chemical Engineering.

DEVELOPMENT OF UNIQUE CATALYSTS FOR HYDRODENITROGENATION OF COAL-DERIVED LIQUIDS Final Report, 15 Sep. 1978 - 15 Sep. 1981

J. R. KATZER, A. B. STILES, and H. KWART 1 Feb 1982 6 p refs

(Contract DE-AC22-78ET-11429)

(DE82-008384; DOE/ET-11429/T2) Avail: NTIS HC A02/MF A01

The objectives of the title research project involved four major tasks defined and summarized below. Briefly, the work was intended to optimize hydrodenitrogenation catalysts by adjusting the C-H bond formation and C-N bond scission functions. Model compounds (i.e., unsaturated multi-ring hetero-organics) were employed to best elucidate the catalyst's N-extraction function, to minimize hydrogenation, and to improve catalyst stability, especially with a view toward coal-derived liquids. The composition and preparation of the catalyst's is described. All were tested for C-N bond scission activity with model compounds. DOE

N83-28165# Pittsburgh and Midway Coal Mining Co., Englewood, Colo.

SOLVENT-REFINED-COAL (SRC) PROCESS. SRC-II FEEDSTOCK SCREENING METHODS Interim Report, 1 Jan. 1980 - 30 Sep. 1981

M. E. PRUDICH Jan. 1982 82 p refs

(Contract DE-AC05-76ET-10104)

(DE82-011500; DOE/ET-10104/31) Avail: NTIS HC A05/MF A01

The SRC-II Feedstock Screening Methods project has as its objective the development of a reliable method of feedstock screening for use in the selection and ranking of coals suitable for use in SRC-II processing. A comprehensive data base has been assembled which includes 123 SRC-II runs made feeding 37 different coals, batches of coals, or mixtures of coals in either the Merriam pilot unit or the P-99 PDU. These data were used to formulate correlative reactivity predictors for the total liquid product insoluble organic matter, and organic vacuum bottoms yields. In addition, a comparison was made between reactivities as determined by runs made on the 1/2-ton/day P-99 PDU and reactivities determined by runs made under a subcontract to the Pennsylvania State University using a continuous, 500-ml CSTR reactor. DOE

N83-28168# Erlangen-Nuremberg Univ. (West Germany). Inst. fuer Technische Chemie.

INVESTIGATIONS ON HYDROLYSIS OF HEAVY CRUDE AND RESIDUAL OIL Final Report, Dec. 1981

B. SCHUETZE Bonn Bundesministerium fuer Forschung und Technologie Feb. 1983 153 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-83-010, ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32

Hydrolysis of heavy crude and residual oil at temperatures above 500C and pressures below 50 bar was investigated. The reaction temperature was adjusted between thermal cracking and steam cracking, to give short-time hydrolysis in a spray reactor. Experiments show that the reactor behaves like a combination of a continuously stirred tank and a plug flow reactor. The hydrolysis produces an alkane-rich gas and a liquid rich in aromatics. With appropriate fluid dynamics coke production can be prevented. The conversion of the hydrolysis is in a range between hydrotreating and hydrocracking, however with considerable gasification. Author (ESA)

N83-28169# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering

SOLID FUEL COMBUSTION CHAMBER: INITIAL PHASE Progress Report, Jul. 1982

H. F. R. SCHOEYER and P. A. O. G. KORTING Jun 1982 22 p refs Prepared in cooperation with Prins Maurits Lab. TNO (VTH-LR-354; PML-1982-134, PR-1) Avail: NTIS HC A02/MF A01

A solid fuel combustion chamber was tested with polymethyl methacrylate as a fuel and an N₂/O₂ mixture as gaseous oxidizer at 1 Mpa for 10 sec. The mixture ratio varied between 0.24 and 1.50 (by weight). At a mixture ratio 4 it is not possible to achieve sustained combustion. Experiments with a diaphragm show different regression behavior of the fuel. The regression rate was also determined ultrasonically. Swirl flow meter measurements show that the flow needs 5 sec before stationary conditions are achieved. The gas supply system is described. Author (ESA)

N83-28170# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

SOLID FUEL COMBUSTION CHAMBER: FIRST PHASE Progress Report 2, Jul. - Dec. 1982

H. F. R. SCHOEYER, P. A. O. G. KORTING, and J. B. VOS Dec. 1982 14 p refs Prepared in cooperation with Prins Maurits Lab. TNO

(VTH-LR-363; PML-1982-159) Avail: NTIS HC A02/MF A01

A solid fuel combustion chamber was tested with polymethyl methacrylate as fuel and N₂-O₂ mixtures as gaseous oxidizer. The mixture ratio was varied between 100% O₂ and 20% O₂/80% N₂. At the latter mixture ratio sustained combustion is achieved. Where no combustion is achieved, the regression rate is pressure dependent, and is severely affected by oscillations. Although an ultrasonic technique to determine the local and instantaneous regression rate is promising, there are severe problems with data reduction and interpretation of the results. Tests with polyethylene as a fuel and pure oxygen as oxidizer were made. Radiation temperature measurements with a hybrid rocket engine are within 10% of the expected theoretical temperature. Author (ESA)

N83-28219# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

FAILURE OBSERVATIONS OF PRESSURIZED TUBES OF CANDIDATE ALLOYS IN 9900 C COAL-GASIFICATION ATMOSPHERES

G. R. SMOLIK Feb 1983 44 p refs

(Contract DE-AC07-76ID-01570)

(DE83-009191; EGG-FM-6187) Avail: NTIS HC A03/MF A01

Causes for failures in pressurized tubes of alloys in high temperature simulated coal gasification atmospheres (CGAs) were investigated. The influences of cyclic loading was studied. Throttling valves were used in a 6.89 MPa test system to vary the magnitude of cyclic loads. A limited number of scoping tests were performed to determine lifetimes, defined as time for perforation. Metallography was also performed to identify reactant products and damage associated with corrosion and cracking present in tube specimens. Reductions of lifetime in air for two alloys, Incoloy 800 H and Haynes 188 are indicated. Severe corrosion occurred in three alloys exposed in simulated CGAs. This severe corrosion and inadequate control of cyclic loading variables prevents a quantitative assessment of relative influences of biaxial stress and cyclic loading upon enhanced corrosion. DOE

N83-28257# Naval Research Lab., Washington, D. C. Combustion and Fuels Branch.

FUEL SEDIMENT ANALYSIS BY FSCA Interim Report

M. WECHTER and R. N. HAZLETT 25 Feb. 1983 15 p refs

(Contract ZF65571005)

(AD-A125718; NRL-8673) Avail: NTIS HC A02/MF A01 CSCL 07D

The technique of x-ray photoelectron spectroscopy (XPS, ESCA) was applied to the analysis of sediments which are formed in fuel and which degrade fuel storage stability. Samples studied included sediments formed in a Navy Paraho Shale II DFM fuel by doping

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fuel samples with 2,5-dimethylpyrrole and stressing the mixtures for periods of 4 to 28 days at 80 C. Several naturally occurring sediments were also investigated. Carbon, oxygen, nitrogen, and sulfur spectra were obtained where applicable. Atomic ratio results show indications of changes in sediment composition over time, and indicate that the composition of various fractions associated with a given sediment may differ. Comparisons of the ESCA spectra of induced vs natural sediments indicated some differences particularly in the nitrogen spectra. Some solubility studies were performed to determine effects of stress time on solubility. The sediment fractions remaining after solvent treatment were also subjected to analysis by ESCA. A comparison of their spectra with the sediment spectra taken before solvent treatment indicated differences in the atom ratios. Structural feature comparisons were inconclusive. GRA

N83-28261# Chem Systems, Inc., New York, N.Y.
PARAMETRIC ANALYSIS SUPPORT FOR ALCOHOL-FUELS PROCESS DEVELOPMENT Final Report, 1 Jan. - 30 Jun. 1981
Feb. 1983 169 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE83-008130, SERI/STR-231-1744) Avail: NTIS HC A08/MF A01

Parametric analyses of an alcohol fuels plant producing 50 million gal/y of ethanol by the high temperature dilute acid hydrolysis of aspen wood or corn stover are described. Analyses were carried out by computer simulation. The simulation performs material and energy balances, estimates capital and operating costs, and calculates the selling price of ethanol. Pretreatments and delignification are justified only if the value of lignin is greater than \$0.40/lb. Sensitivity analyses determine the effect of hydrolysis conditions on yield and selling price. It is found that sugar concentration prior to fermentation is justified. DOE

N83-28262# Department of Energy, Grand Forks, N. Dak.
A SURVEY OF SYNFUEL TECHNOLOGY FOR LIGNITE Final Report
E. A. SONDRER 1982 18 p refs Presented at the Alabama Lignite Conf., Birmingham, Ala., 20-21 Jul. 1982
(DE83-006573; DOE/FC-1008; CONF-820769-1) Avail: NTIS HC A02/MF A01

The most important market for lignite will continue to be the electric utility industry, where it is used to fuel large pc-fired boilers serving major regional power grids. However, the growth of this market and technology is being challenged by new and more stringent environmental control requirements, including the international concern over acid rain. Environmental and economic issues could either encourage or limit the development of a synfuels market for lignite depending on the cost effectiveness of the technological solutions that are developed. Clearly the United States needs to develop its coal resources to reduce dependence on imported oil. However, demand for coal derived substitute petroleum is constrained by cost for the foreseeable future. Government policy initiatives and new technology are the keys to removing these constraints in the decades ahead. A crossover point with respect to petroleum and natural gas is reached at some point in the future, which allows synthetic fuels to penetrate the markets now served by oil and gas. DOE

N83-28264# California Univ., Berkeley. Lawrence Berkeley Lab
Energy and Environment Div
LIQUID FUELS BY DIRECT LIQUEFACTION OF BIOMASS
H. G. DAVIS, C. FIGUEROA, and L. L. SCHALEGER Mar. 1982
25 p refs Presented at 5th KTI Ann. High Temp Processing Technol. Symp., Napa Valley, Calif., 9-12 May 1982
(Contract DE-AC02-76SF-00098; DE-AC06-76RL-01830)
(DE82-013011; LBL-14155; CONF-820535-1) Avail: NTIS HC A02/MF A01

Conversion of Douglas fir wood chips to a crude fuel oil, under an atmosphere of carbon monoxide, hydrogen and steam was accomplished by at least two processes. An oil-wood-flour slurry (oil recycle) process was achieved at the cost of extremely high recycle ratio of product oil (about 19/1) and of effluent water. A

single pass, water-slurry process is currently operating a bench-scale continuous liquefaction unit. The feedstock was an aqueous slurry of prehydrolyzed Douglas fir wood chips. Yields of oil product are higher than was estimated from the Albany experience but are consistently lower than achieved by the recycle process. The difference is real, and is caused by a greater formation of water-soluble products such as carboxylic acids in the water-slurry process. No significant difference in either oil yield or product analysis was found when the CO-H₂ reactant gas mixture is replaced by either CO or H₂ alone. DOE

N83-28266# California Univ., Livermore Lawrence Livermore Lab.
HIGH-FREQUENCY ELECTROMAGNETIC PROBING AT LLNL'S LARGE-BLOCK COAL GASIFICATION
K. I. KISHIYAMA 6 Apr 1982 15 p refs
(Contract W-7405-ENG-48)
(DE82-013761; UCID-19356) Avail: NTIS HC A02/MF A01

LLNL is conducting a series of large block coal gasification experiments to further investigate burn-cavity and product-gas phenomenon as a function of various input parameters. These experiments are located on a hillside where the Big Dirty coal seam outcrops near Centralia, Washington. HFEM probing was deployed there between January 4 and January 13, 1982 to help determine the characteristics of the burn-cavity. The main feature of these large block tests is that, after the completed burn, the block could be excavated to map the actual cavity. This will provide an opportunity to compare and verify our data and the accuracy and resolution of the system. Since the burn area was small and the boreholes closely spaced, there was less signal attenuation than in previous experiments. Thus, higher frequencies were used for better resolution. Also, sufficient data was taken to use image reconstruction algorithms to produce a tomograph of the burn-cavity. DOE

N83-28267# California Univ., Livermore Lawrence Livermore Lab.
CONCEPTUAL DESIGN STUDY FY 1981: SYNFUELS FROM FUSION, USING THE TANDEM MIRROR REACTOR AND A THERMOCHEMICAL CYCLE TO PRODUCE HYDROGEN
O. H. KRIKORIAN, ed., R. L. WERNER, T. R. GALLOWAY, G. L. JOHNSON, M. A. HOFFMAN (California Univ., Davis), F. L. RIBE (Washington Univ., Seattle), G. L. WOODRUFF (Washington Univ., Seattle), S. SITARAMAN (Washington Univ., Seattle), T. H. ZERGUINI (Washington Univ., Seattle), D. S. ROWE (Rowe and Associates, Bellevue, Wash.) et al. 9 Feb 1982 347 p refs
(Contract W-7405-ENG-48; DE-AM06-76RL-02225; DE-AT06-76ET-52047)
(DE82-013790, UCID-19311) Avail: NTIS HC A15/MF A01

A scoping and conceptual design study being conducted for the express purpose of evaluating the engineering potential of producing hydrogen by thermochemical cycles, using a tandem mirror fusion driver is represented. The hydrogen thus produced is then used as a feedstock to produce fuels such as methane, methanol, or gasoline. The main objective was to obtain some approximate cost figures for hydrogen production through a conceptual design study. DOE

N83-28269# Department of Energy, Washington, D. C. Assistant Secretary for Fossil Energy
ALTERNATIVE FUELS PRODUCTION PROGRAM. REPORT TO THE CONGRESS OF THE UNITED STATES Semiannual Report
Jun 1982 28 p
(DE82-019401, DOE/FE-0023; REPT-5) Avail: NTIS HC A03/MF A01

This report describes: (1) the provisions of Public Law 96-126 and subsequent legislation enacted by Congress applicable to this program; (2) program accomplishments, reports on the status of the feasibility studies, cooperative agreements, and the Great Plains Gasification Project loan guarantee. Program accomplishments are summarized by types of alternative fuel. DOE

N83-28273# Teledyne CAE, Toledo, Ohio. Turbine Engines.
GAS TURBINE DEMONSTRATION OF PYROLYSIS: DERIVED FUELS Technical Progress Report, 1 Jul. 1979 - 31 Dec. 1981
 G. JASAS and J. KASPER 1982 42 p refs
 (Contract DE-AC03-78ET-13333)
 (DE82-007193; DOE/ET-13333/T1; TPR-3) Avail NTIS HC A03/MF A01

The objective of this program is to demonstrate the feasibility of utilizing pyrolytic oil and char as a fuel for a combustion turbine engine. This is the first phase of an extended program with the ultimate goal of commercializing a gas turbine engine and electrical generating system which is independent of petroleum-based fuels. Maximum use of existing technology and current production engine hardware is being incorporated for a sequence of test evaluations rating from isolated combustor component tests to full scale engine demonstration tests. The technical goals to be achieved during the course of this project are: pyrolytic fuel characterization in terms of its properties and constituents, pyrolytic fuel combustion technology in gas turbine application in terms of pyrolytic oil atomization, quantity of char burned, emissions, performance and associated combustion system aerothermodynamics; pyrolytic fuel (oil and char slurry) handling, mixing, and storage technology, and engine materials compatibility with the pyrolytic fuel and its combustion products DOE

N83-28275# Brookhaven National Lab, Upton, N. Y. Dept. of Energy and Environment
COAL-OIL MIXTURES. AN ALTERNATIVE FUEL FOR THE COMMERCIAL SECTOR Annual Report, fiscal year 1981
 T BUTCHER, C R. KRISHNA, and J SAUNDERS Aug. 1982 77 p refs
 (Contract DE-AC02-76CH-00016)
 (DE83-008472; BNL-551596) Avail: NTIS HC A05/MF A01

Results are presented from a program aimed at identifying the hardware systems required for the implementation of coal-oil mixtures (COM) as a substitute boiler fuel in the commercial sector. Components for a COM burner system were evaluated both in a cold burner system test stand and a small cast iron boiler fitted with a modified retention head burner. Control valves, pumps, atomizers, and strainers were selected and combustion trials were conducted. Results are presented on thermal efficiency and particulate emissions. Agitation of a commercial sector fuel storage tank with a slurry recirculation system was evaluated through model tank tests. The most successful arrangement tested was a set of six nozzles aimed across the tank floor. A fully settled slurry in the model tank was resuspended in three hours and maintained at 98% suspension. Tests were also conducted in a 3800 liter (1000 gallon) vertical tank with a propeller agitator where it was shown that the slurry is easily resuspended. An evaluation of the economics of conversion to COM in the commercial sector is presented. DOE

N83-28456# Southwest Research Inst., San Antonio, Tex. Energy Systems Research Div
EFFECT OF LOW-PROOF ALCOHOL UTILIZATION TO SUPPLEMENT DIESEL FUEL ON ENGINE LIFE EXPECTANCY: INTERNATIONAL HARVESTER D436 Final Report
 W. E. LIKOS and C. A. MOSES Mar 1983 51 p refs
 (Contract DE-AC19-81BC-10467)
 (DE83-006616; DOE/BC-10467-13) Avail: NTIS HC A04/MF A01

A 500 h durability test was conducted to evaluate the effects of using 160 proof ethanol to supplement diesel fuel in a 138 HP diesel engine. The ethanol was sprayed into the intake manifold of the engine at a rate equal to 25% (vol) of the total fuel flow. Performance testing for power and emissions and pre and postinspections of critical components of the engine confirmed that no significant changes occurred to the engine due to the alcohol fueling. It is concluded that alcohol fumigation does not result in serious wear or durability penalties. DOE

N83-28497# Los Alamos Scientific Lab, N. Mex
NUMERICAL SIMULATION OF FRACTURE
 L. G. MARGOLIN and T. F. ADAMS 1982 9 p refs Presented at 23rd Symp. on Rock Mech., Berkeley, Calif., 25 Aug. 1982 (Contract W-7405-ENG-36)
 (DE82-014050, LA-UR-82-1156, CONF-820803-8) Avail NTIS HC A02/MF A01

The Bedded Crack Model (BCM) is a constitutive model for brittle materials. It is based on effective modulus theory and makes use of a generalized Griffith criterion for crack growth. It is used in a solid dynamic computer code to simulate stress wave propagation and fracture in rock. A general description of the model is given and then the theoretical basis for it is presented. Some effects of finite cell size in numerical simulations are discussed. The use of the BCM is illustrated in simulation of explosive fracture of oil shale. There is generally good agreement between the calculations and data from field experiments. DOE

N83-28532*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGIC UTILITY OF IMPROVED ORBITAL MEASUREMENT CAPABILITIES IN REFERENCE TO NON-RENEWABLE RESOURCES
 H STEWART and S. MARSH *In its* The Multispectral Imaging Science Working Group, Vol. 3 5 p 1 Sep. 1982 ERTS
 Avail: NTIS HC A13/MF A01 CSCL 08G

Spectral and spatial characteristics necessary for future orbital remote sensing systems are defined. The conclusions are based on the past decade of experience in exploring for non-renewable resources with reference to data from ground, aircraft, and orbital systems. Two principle areas of investigation are used in the discussion: a structural interpretation in a basin area for hydrocarbon exploration, and a discrimination of altered areas in the Cuprite district in Nevada M.G.

N83-28560# Department of Energy, Bartlesville, Okla. Energy Technology Center
OUTLOOK FOR ENHANCED OIL RECOVERY
 H. R. JOHNSON 1982 10 p refs Presented at the Enhanced Oil Recovery Conf., New Orleans, 3-4 Feb 1982
 (DE82-010464; DOE/BETC/OP-82/4; CONF-820213-1) Avail: NTIS HC A02/MF A01

The potential for enhanced oil recovery, the evolutionary nature of the recovery processes applied in oilfields today, key parameters that describe the technology state-of-the-art for each of the major oil recovery processes, and the nature and key outputs from the current Department of Energy research program on enhanced oil recovery were reviewed. The DOE program is focused on the analysis of ongoing tests and on long range, basic research to support a more thorough understanding of oil process performance. Data from the program will be made available through reports, symposia, and online computer access; the outputs are designed to allow an independent producer to evaluate his own project as an effort to transfer rapidly the technology now being developed. DOE

N83-28561# Cliffs Minerals, Inc., Granville, W. Va.
ANALYSIS OF THE DEVONIAN SHALES IN THE APPALACHIAN BASIN. VOLUME 2: APPENDICES
 Sep 1982 328 p refs 2 Vol.
 (Contract DE-AC21-80MC-14693)
 (DE83-003035, DOE/MC-14693/1296-VOL-2) Avail: NTIS HC A15/MF A01

Thirty three wells were core drilled from 1975 through 1981 for the Eastern Gas Shales Project in the Appalachian Basin. All the fracture data, mechanical characterization tests, stratigraphic projections, geologic structural interpretations, and gas production information were compiled. The well summary charts contain the detailed fracture distributions and mechanical test results for the stratigraphic members cored. The gamma ray log and density log are reproduced on each chart to show the correlation to stratigraphic members of the Devonian Shale sequence. Data were collected to define the relationship of radioactivity to the individual

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shale members. Temperature and noise logs are included to show zones of gas emanation in the well bore. The mechanical test results columns include pretest fractures in the samples, maximum ultrasonic velocity directions, orientation of cracks from point load tests, weakest tensile strength directions from directional tests, and crack orientations from hydrofracture tests when available.

DOE

N83-28563# Sheffield Univ (England)

THE EFFECT OF LARGE-SCALE STRUCTURES ON THE STABILITY OF COAL-FACE STEERING

J. B. EDWARDS and J. KIBBLE (National Coal Board Mining Research and Development Establishment) Sep 1982 37 p refs Submitted for publication Sponsored by National Coal Board Mining Research and Development Establishment (RR-195) Avail: NTIS HC A03/MF A01

Simplified models of piecewise rigid support structures for powerloaders operating on longwall coalfaces are shown to be analyzable by z-transform methods. Such analysis predicts that increasing the length of the structure's subsections sufficiently (compared to the inherent delay within the machine's vertical steering system) stabilizes the vertical steering of the entire coal face. Increasing the width of the structure to embrace more than two consecutive cut floors is shown to eliminate the need for electronic tilt-feedback in control systems. These analytical predictions are shown to hold good in detailed simulations of the system. An increase in the size of support-structure segments can potentially reduce the complexity of steering control systems. The size increase must be substantial (4 to 5 times the conventional size). Author (ESA)

N83-28580*# Faucett (Jack) Associates, Inc., Chevy Chase, Md.

ENERGY AND PRECIOUS FUELS REQUIREMENTS OF FUEL ALCOHOL PRODUCTION. VOLUME 4: APPENDICES G AND H, METHANOL FROM COAL Final Report

H. WEINBLATT, G. BACK, and T. S. REDDY (Battelle Columbus Labs, Ohio) Dec. 1982 68 p refs (Contract DEN3-292; DE-AI01-81CS-50006) (NASA-CR-168093, DOE/NASA/0292-1, NAS 1 26:168093, JACKFAU-82-299-VOL-4) Avail: NTIS HC A04/MF A01 CSCL 10A

Coal mine location, mining technology, energy consumption in mining, coal transport, and potential availability of coal are discussed. Methanol from coal is also discussed. Author

N83-28581*# Faucett (Jack) Associates, Inc., Chevy Chase, Md.

ENERGY AND PRECIOUS FUELS REQUIREMENTS OF FUEL ALCOHOL PRODUCTION, VOLUME 1 Final Report

H. WEINBLATT, M. F. LAWRENCE, and D. JENKINS Dec. 1982 87 p refs Prepared in cooperation with Battelle Columbus Labs. 3 Vol. (Contract DEN3-292; DE-AI01-81CS-50006) (NASA-CR-168090; DOE/NASA/0292-1, NAS 1.26:168090; JACKFAU-82-299-VOL-1) Avail: NTIS HC 05/MF A01 CSCL 10A

Ethanol from grain, methanol from cellulose, and methanol from coal are considered. Author

N83-28642# Waste Management, Inc., Oak Brook, Ill.

ASEF SOLID-WASTE-TO-METHANE GAS, POMPAHO BEACH, FLORIDA, REFCOM Technical Status Report, Oct. 1982 - 12 Jan. 1983

H. P. MOOIJ Jan. 1983 47 p (Contract DE-AC02-76CS-20038) (DE83-006817; DOE/CS-20038/T8) Avail: NTIS HC A03/MF A01

Five graphs are presented to document solid waste to methane experiments. The first simply shows the number of hours spent running in relation to the number of tons of material fed into the digester. The second shows the relationship between tonnage fed and subsequent gas production. Tonnage is further broken down

into moisture, dry, and volatile fractions. The third graph shows the relationship between methane and carbon dioxide in the off gas. The fourth graph shows the pH, alkalinity, and volatile acids in the digester slurry environment. Nutrient levels of the effluent are shown in the fifth graph. Finally, materials analysis and gas production data are tabulated. DOE

N83-28657# Arizona Univ, Tucson Dept. of Chemical Engineering.

EVALUATION OF GEOTHERMAL COOLING SYSTEMS FOR ARIZONA

D. H. WHITE and L. A. GOLDSTONE Aug 1982 50 p refs Prepared for Arizona Solar Energy Commission, Phoenix (Contract DE-FC03-80RA-50076) (DE83-005311, DOE/RA-50076/13) Avail: NTIS HC A03/MF A01

Two geothermal-driven cooling systems namely, absorption cooling and heat pumps, are discussed. Adsorption cooling requires a geothermal resource above 1050C (2200F) in order to operate at a reasonable efficiency and capacity. Geothermal resources at these temperatures or above are believed existing in the Phoenix and Tucson areas, but at such depths that geothermal-driven absorption systems have high capital investments. Such capital investments are uneconomical when paid out over only five months of operation each year, but become economical when cascaded with other geothermal uses. There may be other regions of the state, where geothermal resources exist at 1050C (2200F) or higher at much less depth, such as the Casa Grande/Coolidge or Hyder areas, which might be attractive locations for future plants of the high-technology industries. Geothermal assisted heat pumps are shown to be economical for nearly all areas of Arizona. They are more economical and reliable than air-to-air heat pumps. Such systems in Arizona depend upon a low-temperature geothermal resource in the narrow range of 15.5 to 26.60C (60 to 800F), and are widely available in Arizona. DOE

N83-28675# Engineering and Economics Research, Inc., Falls Church, Va.

HYDROTHERMAL RESEARCH AND DEVELOPMENT ASSESSMENT. TASK FORCE REPORT: PROJECTIONS FOR DIRECT-HEAT APPLICATIONS

Apr 1982 105 p refs (Contract DE-AC07-80ID-12154) (DE82-017012; DOE/ID-12154/T2) Avail: NTIS HC A06/MF A01

Low and moderate temperature hydrothermal resources suitable for direct heat applications were identified in 37 states. The extent to which three resources might be used over the next 20 years were evaluated and the probable impact of Federal programs on hydrothermal resource utilization was assessed. The use types that comprise the bulk of the market were determined. Representative firms and municipalities were interviewed to determine their willingness to use hydrothermal energy, and to determine the investment decision criteria that would influence their actions. DOE

N83-28676# Coury and Associates, Inc., Lakewood, Colo. **GEOTHERMAL UTILIZATION AT CASTLE OAKS SUBDIVISION, CASTLE ROCK, COLORADO Final Report**

K. L. GARING, G. E. COURY, and S. W. GOERING Apr. 1982 39 p refs (Contract DE-AC07-76ID-01570) (DE82-013644; EGG-2154) Avail: NTIS HC A03/MF A01

Designs of geothermal systems for using warm water from four aquifers of the Denver Basin are presented. Advantages of using heat pumps with the geothermal resource are discussed. Two design cases, one with separate heat load and heat pump, and the other with the heat pump and heat load located at the well site are evaluated in terms of pump costs, operating costs, and payback periods. The 20 year delivered energy costs for the two geothermal systems would be slightly less than those for natural gas (\$5.64 to \$6.42 versus \$6.70 per million Btu). DOE

N83-28678# Sandia Labs., Albuquerque, N. Mex.
ANALYSIS OF MAGMA-THERMAL CONVERSION OF BIOMASS TO GASEOUS FUEL

T. M. GERLACH Feb. 1982 55 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-009351; SAND-82-0031) Avail: NTIS HC A04/MF A01

A wide range of magma types and pluton geometries believed to occur within the upper 10 km of the crust provide suitable sources of thermal energy for conversion of water-biomass mixtures to higher quality gaseous fuel. Gaseous fuel can be generated within a magma body, within the hot subsolidus margins of a magma body, or within surface reaction vessels heated by thermal energy derived from a magma body. The composition, amount, and energy content of the fuel gases generated from water-biomass mixtures are not sensitive to the type, age, depth, or temperature of a magma body thermal source. The amount and energy content of the generated fuel is almost entirely a function of the proportion of biomass in the starting mixture. CH₄ is the main gas that can be generated in important quantities by magma thermal energy under most circumstances. The rates at which gaseous fuels can be generated are strongly dependent on magma type. The highest fuel generation rates, for any particular magma body, will be achieved at the lowest possible reaction vessel operating temperature that does not cause graphite deposition from the water-biomass starting mixture. DOE

N83-28683# Oak Ridge National Lab, Tenn. Engineering Technology Div.

DISTRICT HEATING/COGENERATION APPLICATION STUDIES FOR THE MINNEAPOLIS-ST. PAUL AREA: ECONOMIC COMPARISON OF NEW COAL-FUELED, COGENERATION POWER PLANTS FOR DISTRICT HEATING AND ELECTRICITY-ONLY AND HEAT-ONLY POWER PLANTS

G. A. ENGLESON, G. F. PAVLENCO, J. S. HODSON, N. H. LEE, A. N. GARCIA, and B. J. MENAKER May 1982 135 p refs

(Contract W-7405-ENG-26)
 (DE82-016598; ORNL/TM-6830/P8) Avail: NTIS HC A07/MF A01

Cogeneration/district heating plants equipped with condensating-tail turbines and full-sized heat rejection systems cost approximately 3% more than comparable sized electric-only plants. Bus bar electricity costs of cogeneration plants are comparable with those of an 800-MW(e) electric-only plant. The cost of bus bar electricity is practically independent of the two sites evaluated, but the heat delivered to the load center from the Coon Rapids site is 30 to 50% more costly than the heat delivered from the High Bridge site because of the greater transmission distance from the Coon Rapids site. The cogeneration plant operating at its assigned capacity factor will provide heat and electricity at the plant boundary at significantly less cost than will separately sized heat-only and electricity-only plants because of (1) better fuel utilization, (2) common use of facilities, and (3) the sale of two products - heat and electricity. DOE

N83-28685# Sandia Labs., Albuquerque, N. Mex.
COMPARATIVE EVALUATION OF SURFACE AND DOWNHOLE STEAM-GENERATION TECHNIQUES

C. HART 1982 13 p refs Presented at the Enhanced Oil Recovery Symp., Tulsa, Okla., 4 Apr. 1982
 (Contract DE-AC04-76DP-00789)
 (DE82-011136; SAND-81-2244C; CONF-820419-1) Avail: NTIS HC A02/MF A01

The application of heat to reservoirs containing high API gravity oils can substantially improve recovery. Although steam injection is currently the principal thermal recovery method, heat transmission losses associated with delivery of the steam from the surface generators to the oil bearing formation has limited conventional steam injection to shallow reservoirs. The objective of the Department of Energy's Project DEEP STEAM is to develop the technology required to economically produce heavy oil from deep reservoirs. The tasks included in this effort are the development and evaluation of thermally efficient delivery systems

and downhole steam generation systems. The technical and economic performance of conventional surface steam drives, which are strongly influenced by heat losses are compared. The selection of a preferred technology based upon either total efficiency or cost is found to be strongly influenced by reservoir depth, steam mass flow rate, and sandface steam quality. DOE

N83-28689# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

FAST BIOMASS PYROLYSIS WITH AN ENTRAINED-FLOW REACTOR

M. S. BOHN and C. BENHAM Feb. 1982 29 p refs Presented at the AIChE 1982 Natl. Winter Meeting, Orlando, Fla., 28 Feb. 1982

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
 (DE82-011266; SERI/TP-252-1398; CONF-820202-6) Avail: NTIS HC A03/MF A01

A tubular entrained flow reactor has been used to study the effect of process control variables on fast biomass pyrolysis. In this type of reactor, finely ground biomass particles are entrained by carrier gas and transported through a reactor tube which is heated to about 900 C. Biomass particles pyrolyze as a result of heat transfer from the reactor wall yielding a gas composed primarily of carbon monoxide, carbon dioxide, hydrogen, methane, and unsaturated hydrocarbons. In this experimental program three dependent variables, percent conversion to gas, gas composition, and process heat, have been measured as a function of several process control variables. These process variables include reactor temperature, carrier gas to biomass flow ratio, reactor residence time, biomass particle size, and reactor Reynolds number. The data allow one to design and predict the performance of large scale reactors and also elucidates heat transfer mechanisms in fast biomass pyrolysis. DOE

N83-28690# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Systems Div

PHOTOVOLTAIC SYSTEM DESIGN IN GRID-CONNECTED APPLICATIONS

G. J. JONES 1982 4 p refs Presented at the Am. Sect. of the Intern. Solar Energy Soc. Conf., Houston, Tex., 1 Jun 1982
 (Contract DE-AC04-76DP-00789)

(DE82-012450; SAND-82-0923C; CONF-820629-6) Avail: NTIS HC A02/MF A01

The design of photovoltaic (PV) systems was traditionally done from the owner's viewpoint. This does not present a problem in central station applications but may result in misleading guidance for distributed system configurations. The results of the traditional design approach are contrasted with those obtained when the utility and application are viewed as a whole. The typical design assumes that on-site energy use must be maximized leading to a synergism between on-site loads and design optimization. This is shown to be a false requirement, resulting from considering only the system owner. When the system and utility are viewed together, the value of PV energy is found to be independent of the point of consumption. Load management, conservation, and passive solar design may affect energy use but have no impact on PV energy value. Furthermore, the value of PV energy is essentially the same for all systems, whether distributed or centralized. DOE

N83-28691# Sandia Labs., Albuquerque, N. Mex.
IMPACT OF PHOTOVOLTAIC-ARRAY CONVERSION EFFICIENCY ON SYSTEM ENERGY COST

G. J. JONES and H. N. POST 1982 23 p refs Presented at the Spring Meeting of the Electrochem Soc., Montreal, 9 May 1982

(Contract DE-AC04-76DP-00789)
 (DE82-014688; SAND-82-1119C; CONF-820508-2) Avail: NTIS HC A02/MF A01

The relationship between photovoltaic collector efficiency and total system cost is analyzed using the most recent data on subsystem costs. Results are compared with competitive system prices to determine minimum array efficiency requirements. Central power station results show a requirement for arrays with a 10

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percent minimum efficiency even for inexpensive collectors. For intermediate applications, this required minimum drops to 6 to 7 percent for the same collectors. Residential systems would seem to allow much lower efficiencies but are probably constrained by the available roof area. DOE

N83-28692# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

PHOTOVOLTAIC-SYSTEMS DEVELOPMENT: BEST LOCATIONS FOR NEAR-TERM RESIDENTIAL APPLICATIONS

G. FERRIS, G. SUSSMAN, and T. THOMAS Jul 1982 91 p refs

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE82-018193; SERI/TR-254-1542) Avail: NTIS HC A05/MF A01

This study identifies urban locations where the development of residential photovoltaic energy systems can reasonably be expected in the near future. PV system costs and values used in the analysis are based on US Department of Energy estimates and forecast. The analysis assumes first that all state and federal policies affecting the price of PV systems in 1980-1981 will be in effect in 1984. Thus, DOE cost goals for PV systems are reduced to reflect various state and federal subsidies applicable in 1980-1981. The method used to identify likely urban areas is conjoint analysis. Each US (Continental) Standard Metropolitan Statistical Area's potential as a market for residential PV systems is determined first. Second, a small set of location descriptions are ranked according to the decision maker's evaluation of each location's market potential for residential PV systems. Fourth, the rankings assigned by the experts are evaluated by means of regression equations to derive weights for defining the relative importance of each set of location characteristics. DOE

N83-28693# Sandia Labs, Livermore, Calif. Large Power Systems Div.

SOLAR REPOWERING ASSESSMENT

J. C. GIBSON Jun. 1982 57 p refs

(Contract DE-AC04-76DP-00789)

(DE82-017801; SAND-81-8015) Avail: NTIS HC A05/MF A01

Provided is the assessment of solar repowering studies that were completed by 1980. The ease of interfacing with existing plants, the interest expressed by plant managers in the central receiver concept, and the awareness on the part of industry of the need to develop alternative energy sources all point to near term high potential for solar central receiver technology. A major barrier to private investment appeared to be the need for larger experimental projects to establish actual costs and develop initial operating experience. DOE

N83-28698# Geokinetics, Inc., Salt Lake City, Utah. **INVESTIGATION OF THE GEOKINETICS HORIZONTAL IN-SITU OIL-SHALE-RETORTING PROCESS Annual Report, 1981**

E. C. COSTIMIRIS, ed. Jul. 1982 169 p

(Contract DE-FC20-78LC-10787)

(DE82-018581; DOE/LC-10787/89; AR-5) Avail: NTIS HC A08/MF A01

The objective of the Geokinetics in situ shale oil project is to develop a true in situ process for recovering shale oil using a fire front moving in a horizontal direction. The project is conducted at a field site, Kamp Kerogen, Utah. During 1981, one full sized retort was blasted and the following three retorts were processed: (1) retort No. 24 operations were continued until July 23; (2) retort No. 23 was ignited and processed during the calendar year; (3) retort No. 25 was ignited and burned for 77 days during 1981. DOE

N83-28702# Nevada Univ., Las Vegas. Div. of Earth Sciences. **GEOHERMAL ASSESSMENT OF THE MX DEPLOYMENT AREA IN NEVADA Final Report**

D. T. TREXLER, J. L. BRUCE, D. CATES, and C. COVINGTON

Jun 1982 137 p refs

(Contract DE-AC08-81NV-10187)

(DE82-019198; DOE/NE-10189/1) Avail: NTIS HC A07/MF A01

A preliminary geothermal resource assessment of the MX deployment area in Nevada focused on Coyote Spring Valley in southeastern Nevada. Initially, an extensive literature search was conducted and a bibliography consisting of 750 entries was compiled covering all aspects of geology pertaining to the study area. A structural study indicates that Coyote Spring Valley lies in a tectonically active area which is favorable for the discovery of geothermal resources. Hot water may be funneled to the near surface along an extensive fracture and fault system which appears to underlie the valley, according to information gathered during the literature search and aerial photo survey. A total of 101 shallow temperature probes were implanted in Coyote Spring Valley. Three anomalous temperature points all lying within the same vicinity were identified in the north central portion of the valley near a fault. DOE

N83-28703# Geological Survey, Denver, Colo. **GEOHERMAL RESOURCE ASSESSMENT OF RANGER WARM SPRING, COLORADO, RESOURCES SERIES 24**

T. G. ZACHARAKIS, R. H. PEARL, and C. D. RINGROSE 1982 72 p refs

(Contract DE-AS07-77ET-28365)

(DE83-009097; DOE/ET-28365/26) Avail: NTIS HC A04/MF A01

The delineation of the geological features controlling the occurrence of geothermal resources in Colorado are discussed. The program consists of literature search, reconnaissance geological and hydrogeologic mapping and geophysical and geochemistry surveys. During 1980 and 1981 geothermal resource assessment were conducted in the Cement Creek Valley south of Crested Butte. In this valley are two warm springs, Cement Creek and Ranger. The temperature of both springs is 77 to 790F and the discharge ranges from 60 to 195 gallons per minute. Electrical resistivity and soil mercury surveys were conducted at Ranger Warm Springs. The bedrock of the area consists of sedimentary rocks ranging in age from Precambrian to recent. Several faults with displacements of up to 3000 ft are found and one of these faults passes close to the Ranger Warm Springs. The electrical resistivity survey indicates that the water of Ranger Warm Springs are moving up along a buried fault which parallels Cement Creek. DOE

N83-28704# Geological Survey, Denver, Colo. **GEOHERMAL RESOURCE ASSESSMENT OF THE STEAMBOAT-ROUTT HOT SPRINGS AREA, COLORADO, RESOURCES SERIES 22**

R. H. PEARL, T. G. ZACHARAKIS, and C. D. RINGROSE 1983 95 p refs

(Contract DE-AS07-77ET-28365)

(DE83-009096; DOE/ET-28365/24) Avail: NTIS HC A05/MF A01

The geological features controlling the occurrence of the thermal waters (temperatures in excess of 680F in the area at Steamboat Springs and 8 miles north at Routt Hot Springs) were delineated. Thermal waters from Heart Spring, the only developed thermal water source in the study area, are used in the municipal swimming pool in Steamboat Springs. The assessment program consisted of: dipole dipole, Audio magnetotelluric, telluric, self potential and gravity geophysical surveys, soil mercury and soil helium geochemical surveys; shallow temperature measurements; and preparation of geological maps. It is shown that all the thermal springs appear to be fault controlled. It appears that Heart Spring in Steamboat Springs is hydrologically related to the Routt Hot Springs. Thermal waters were encountered during the construction of the new high school on the north side of Steamboat Springs.

Strawberry Park also appears to be warmer than the surrounding country side. Geological mapping determined that a major fault extends from the Routt Hot Springs area into Strawberry Park.

DOE

N83-28708# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY AND TECHNOLOGY REVIEW

P. S. BROWN, ed., R. B. CRAWFORD, ed., M. A. ESSER, ed., P. L. LIEN, ed., E. M. ONEAL, ed., and P. T. VANDYKE, ed. Jan. 1983 39 p refs

(Contract W-7405-ENG-48)

(DE83-009213; UCRL-52000-83-1) Avail: NTIS HC A03/MF A01

Predictive models for forecasting hazards resulting from LNG spills were evaluated. It is verified that a large cloud behaves quite differently from a small one. Clouds enriched by heavier hydrocarbons resulting from differential boiloff may be more easily detonated. The RPT explosions may play an important role in determining the outcome of a spill. Model calculations were compared with the data from cloud dispersion tests. The sophisticated three dimensional FEM3 model successfully accounted for cloud bifurcation and terrain effects and gave accurate values for measured downwind LFL. The simpler cross wind averaged SLAB model also gave reasonable LFL values. The comparisons also revealed serious deficiencies in Gaussian models. It is confirmed that 40-m (3) LNG experiments mark a threshold for observing large cloud effects. It is suggested that models that can reproduce the 40-m (3) results should be used to predict the behavior of larger spills.

DOE

N83-28709# Sandia Labs., Livermore, Calif Systems Research Div

ECONOMICS OF SCALE IN THE PRODUCTION OF STEAM WITH SOLAR THERMAL-FOSSIL BOILER HYBRID SYSTEMS

F. R. HANSEN, D. L. LINDNER, and J. VITKO, JR. Mar 1983 99 p refs

(Contract DE-AC04-76DP-00789)

(DE83-009359; SAND-83-8202) Avail: NTIS HC A05/MF A01

Levelized energy costs for steam plants in the size range 15 MM Btu/h to 400 MM Btu/h were estimated for steam produced by several different technologies, including stand alone oil and coal burning plants and solar central receiver fossil boiler hybrid plants. Models for the costs of plant subsystems used in these calculations are presented. Designs of the solar fossil hybrids examined were optimized for solar fraction and amount of thermal storage used by simulation of plant operation. The resulting levelized energy costs and their sensitivity to various modelling parameters are discussed.

DOE

N83-28718# Department of Energy, Washington, D C Div. of Geothermal Energy.

GEOTHERMAL MONITOR REPORT Progress Report

Jun. 1982 95 p

(DE82-013757; DOE/CE-0009/6; PR-6) Avail: NTIS HC A05/MF A01

Geothermal Progress Monitor Report No. 6 presents a state-by-state summary of the status of geothermal leasing, exploration, and development in major physiographic regions where geothermal resource potential has been identified. Recent state-specific activities are reported at the end of each state status report, while recent activities of a more general nature are summarized briefly in Part 2 of the report. A list of recent publications of potential interest to the geothermal community and a directory of contributors to the geothermal progress monitoring system are also included.

DOE

N83-28719# New Mexico State Univ., Las Cruces Dept. of Mechanical Engineering.

HYDROTREATING OF COAL LIQUIDS, PHASE 2 Final Report

D. B. WILSON and J. M. BOGDANOR Jun 1982 134 p refs

(DE82-905315; NP-2905315) Avail: NTIS HC A07/MF A01

The kinetic parameters for the pseudo first-order denitrogenation and desulfurization of an SASOL coal naphtha was studied. Only the fraction boiling over 95 C (at 25.8 mmHg) was hydrotreated due to the high volatility of the whole naphtha. Dodecane was used as a diluent to further reduce the volatility of the hydrotreated naphtha bottoms. A commercial Ni-Mo catalyst (HDS9A) was employed. Based on chromatographic results, nitrogen and sulfur were successfully removed from the naphtha bottoms. The mathematical model developed to describe the pseudo first-order denitrogenation and desulfurization of the naphtha bottoms in the semi-batch, slurry reactor was adequate to explain the experimental results.

DOE

N83-28732# Reinke (Ralph G.), Wausau, Wis.

DISTILLING ALCOHOL WITH WASTE AUTOMOBILE HEAT Final Report

R. REINKE 30 Jun. 1982 11 p

(Contract DE-FG02-81AF-92017)

(DE82-018821; DOE/AF-92017/T3) Avail: NTIS HC A02/MF A01

The distillation unit to be cost effective would have to be fabricated and installed by a skilled but free labor do-it-yourselfer or hobbyist. A manufacturer would not risk a large production run to reduce fabrication cost because of the operational problems which make the end result marginal. Similarly the variations of the automobiles would require custom fitting the unit to the car. The operational methods including permits and EPA rules seriously restrict this type operation for anything other than experiments and as a hobby. An acute shortage of fuel would have to take place where availability takes precedence over cost and convenience before the production of the unit would be worth investing. Drawings, fabrication instructions and parts lists are included.

DOE

N83-28742# Brookhaven National Lab., Upton, N. Y. Process Sciences Div

FLASH PYROLYSIS OF BIOMASS WITH REACTIVE AND NON-REACTIVE GASES Summary Report, Mar. 1982 - Mar. 1983

M. STEINBERG, P. T. FALLON, and M. S. SUNDARAM Mar. 1983 25 p refs Presented at the 15th Biomass Thermochem. Conversion Contractors' Meeting, Atlanta, 16-17 Mar. 1983

(Contract DE-AC02-76CH-00016)

(DE83-010852; BNL-32746; CONF-830323-2) Avail: NTIS HC A02/MF A01

The process chemistry of the flash pyrolysis of biomass (wood) with the reactive gases, H₂ and CH₄ and with the nonreactive gas He was determined in a 1 in. downflow tubular reactor. It is found that with hydrogen, flash hydrolysis leads to high yields of methane and CO which can be used for SNG and methanol production. With methane, flash methanolysis of wood, leads to high yields of ethylene, benzene and CO which can be used for the production of valuable feedstocks and methanol fuel. At reactor conditions of 50 psi and 10,000 C and approximately 1 sec residence time, the ethylene yield based on wood carbon converted is 22%, benzene 12% and the CO yield is 48%. The yield of ethylene is 2.2 times higher with methane than with helium, which indicates a free radical reaction between CH₄ and the pyrolyzed wood. A preliminary process analysis indicates an economically competitive process for the production of ethylene, benzene and ethanol based on the methanolysis of wood. The development of the data base for the flash pyrolysis of wood and other biomass materials with methane and other reactive gases and the determination of the role of the hemicellulose and lignin in the formation of these valuable fuels and feedstocks are recommended.

DOE

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N83-28763# Washington Univ., Seattle.

TRACE-METAL CHARACTERIZATION AND SPECIATION IN GEOTHERMAL EFFLUENT BY MULTIPLE-SCANNING ANODIC-STRIPPING VOLTAMMETRY AND ATOMIC-ABSORPTION ANALYSIS Final Report

B. R. KOWALSKI 1982 11 p

(Contract DE-AT06-76EV-70048)

(DE82-018603; DOE/EV-70048/T1) Avail: NTIS HC A02/MF A01

The in-field sampling equipment constructed, procedures developed or adapted, and the results obtained on representative samples taken from geothermal sites are described DOE

N83-28765# Los Alamos Scientific Lab., N. Mex.

HEAT-FLOW RECONNAISSANCE OF THE GULF COASTAL PLAIN

D. L. SMITH and S. S. SHANNON, JR. Apr. 1982 40 p refs (Contract W-7405-ENG-36)

(DE82-015898; LA-9222-HDR) Avail: NTIS HC A03/MF A01

Most of the 46 new values of heat flow determined for the Gulf Coastal Plain are in the low to normal range, but heat flow values averaging 1.8 heat flow unit (HFU) were obtained in Claiborne, Ouachita, and Union parishes, Louisiana. Moreover, a zone of relatively high heat flow values and steep thermal gradients (35 to 46 C/km) extends from northern Louisiana into southwestern Mississippi. Also near Pensacola, Florida, temperatures of 50 C at 1 km depth were extrapolated from thermal gradients. Future development of low grade geothermal resources may be warranted in these areas. DOE

N83-28804# Los Alamos Scientific Lab., N. Mex.

EXPLOSIVELY PRODUCED FRACTURE OF OIL SHALE Progress Report, Oct. - Dec. 1981

W. A. MORRIS May 1982 23 p refs

(Contract W-7405-ENG-36)

(DE82-016405; LA-9286-PR) Avail: NTIS HC A02/MF A01

Rock fragmentation research in oil shale to develop the blasting technologies and designs required to prepare a rubble bed for a modified in situ retort is reported. Experimental work is outlined, proposed studies in explosive characterization are detailed and progress in numerical calculation techniques to predict fracture of the shale is described. A detailed geologic characterization of two Anvil Points experiment sites is related to previous work at Colony Mine. The second section focuses on computer modeling and theory. The latest generation of the stress wave code SHALE, its three dimensional potential, and the slide line package for it are described. A general stress rate equation that takes energy dependence into account is discussed. DOE

N83-28805# Coupland, Moran and Associates, Albuquerque, N. Mex.

UTILIZATION OF GEOTHERMAL ENERGY-FEASIBILITY STUDY, OJO CALIENTE MINERAL SPRINGS COMPANY, OJO CALIENTE, NEW MEXICO

Apr. 1982 97 p Prepared for Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

(Contract DE-AC07-76ID-01570)

(DE82-013645; EGG-2149) Avail: NTIS HC A05/MF A01

The feasibility of a geothermal heating system at the Ojo Caliente Mineral Springs Co. was investigated. The geothermal energy will be used to preheat hot water for the laundry facilities and to heat the water for a two pipe fan coil heating system in the hotel. Present annual heating fuel costs of \$11,218 for propane will be replaced by electricity to operate fans and pump at an annual cost of \$2547, resulting in a net savings of \$8671. Installation costs include \$10,100 for a well system, \$1400 for a laundry system, and \$41,100 for a heating system. With the addition of a 10% design fee the total installation cost is \$57,860. Ignoring escalating propane fuel prices, tax credits for energy conservation equipment, and potential funding from the State of New Mexico for a geothermal demonstration project, the simple economic payback period for this project is 6.7 years. DOE

N83-28806# Nevada Univ., Reno Seismological Lab
SEISMICITY RELATED TO GEOTHERMAL DEVELOPMENT IN DIXIE VALLEY, NEVADA Final Technical Report, 16 Aug. 1979 - 15 Dec. 1981

A. S. RYALL and U. R. VETTER 8 Jul. 1982 106 p refs

(Contract DE-AC08-79NV-10054; DI-14-08-0001-19299)

(DE82-018081; DOE/NV-10054/3; USGS-14-08-0001-19299-2)

Avail: NTIS HC A06/MF A01

A ten-station seismic network was operated in and around the Dixie Valley area from January 1980 to November 1981; three of these stations are still in operation. Data from the Dixie Valley network were analyzed through 30 June 1981, and results of analysis were compared with analysis of somewhat larger events for the period 1970-1979. The seismic cycle in the Western Great Basin, the geologic structural setting, and the instrumentation are also described. DOE

N83-28811# West Virginia Univ., Morgantown. Dept. of Geology and Geography.

SHALLOW SEISMIC INVESTIGATIONS OF DEVONIAN-SHALE GAS PRODUCTION

R. T. WILLIAMS, J. E. RUOTSALA, J. J. KUDLA, and W. E. DUNNE Jun. 1982 218 p refs

(Contract DE-AT21-80MC-14394)

(DE83-008964; DOE/MC-14394/1365) Avail: NTIS HC A10/MF A01

Fractured Devonian shale gas reservoirs which are detectable by seismic reflection methods is discussed. The preferred exploration rationale is based on travel time anomalies related to lowered acoustic velocity within the gas bearing zone. In the simplest case the travel time anomaly causes an apparent down warp or sag in a flat lying reflector. The high resolution extension of the seismic method drew two separate conclusions: (1) additional, valuable subsurface information can be obtained by recording seismic data at frequencies higher than those in common use by the petroleum industry; and (2) it is feasible to obtain seismic reflection data on a smaller scale, using less costly instrumentation, than is typically employed in the petroleum industry. DOE

N83-28812# Terra Tek, Inc., Salt Lake City, Utah.

PHYSICAL PROCESSES OF SUBSIDENCE IN GEOTHERMAL RESERVOIRS

J. F. SCHATZ, K. WOLGEMUTH, S. CARLISLE, M. SMITH, and A. ABOU-SAYED Jun. 1982 151 p refs

(Contract DE-AC03-76SF-00098)

(DE83-011017; LBL-14605; GSRMP-12; TR-82-39) Avail: NTIS HC A08/MF A01

The acquisition of core and fluid from producing geothermal reservoirs was presented. The testing of specimens of this core for their short term and long term compaction response; and the development of a compaction constitutive model that would allow future analysis of reservoir compaction and a surface subsidence was investigated. Depths and porosities ranged from 3500 to 11,000 feet and 15 to 40, respectively. Several samples of geothermal fluids were also obtained. Selected specimens were tested for their response to the pressures and temperatures of the geothermal environment and to simulated changes in those conditions caused by production. Short term tests indicate that these sedimentary materials behave normally with respect to the expected behavior of reservoir sandstones of these depths and porosities. Compressibilities are of the order 1×10^{-6} psi. Long term tests indicate that pore pressure reduction, simulating reservoir production, tend to cause creep compaction at an initial rate of about 1×10^{-7} % porosity reduction per second. DOE

N83-29020# Enviro Control, Inc., Rockville, Md.
FIELD-SIMULATION ANALYSIS FOR DISPOSAL OF LIQUEFACTION SOLID WASTE Quarterly Technical Progress Report

14 May 1982 65 p refs
 (Contract DE-AC22-81PC-42682)
 (DE82-017688; DOE/PC-42682/T2; QTPR-2) Avail: NTIS HC A04/MF A01

Several leaching test methods that can be used to generate inputs into the field simulation models are identified. Recommendations as to those most suited for use with coal liquefaction wastes are made. A number of general considerations for classifying sites and situations prior to model selection are presented. Also, the general categories of models are discussed.

DOE

N83-29022# Department of Energy, Richland, Wash
SPENT-FUEL STORAGE REQUIREMENTS

Jun. 1982 85 p refs Updates DOE/SR-0007
 (Contract DE-AC06-76RL-01830)
 (DE82-019411; DOE/RL-82/1; DOE/SR-0007) Avail NTIS HC A05/MF A01

Spent fuel storage requirements, as projected through the year 2000 for U.S. LWRs, were calculated using information supplied by the utilities reflecting plant status as of December 31, 1981. Projections through the year 2000 combined fuel discharge projections of the utilities with the assumed discharges of typical reactors required to meet the nuclear capacity of 165 GWe projected by the Energy Information Administration for the year 2000. Three cases were developed and are summarized. A reference case, or maximum at-reactor capacity case, assumes that all reactor storage pools are increased to their maximum capacities as estimated by the utilities for spent fuel storage utilizing currently licensed technologies. The reference case assumes no transshipments between pools except as current licensed by the Nuclear Regulatory Commission. This case identifies an initial requirement for 13 MTU of additional storage in 1984, and a cumulative requirement for 14,490 MTU additional storage in the year 2000

DOE

N83-29023# California Univ., Livermore. Lawrence Livermore Lab.

THE FUSION BREEDER

R. W. MOIR 20 Apr. 1982 59 p refs Presented at the National Science Foundation Policy Workshop on End-Use Products of Fusion Energy: Alternatives and Their Implications to the Fusion R and D Strategy, Washington, D.C., 4-5 Mar. 1982 (Contract W-7405-ENG-48)
 (DE82-013794; UCRL-87290-REV-1; CONF-820351-1-REV-1)
 Avail: NTIS HC A04/MF A01

The fusion breeder is a fusion reactor designed with special blankets to maximize the transmutation by 14 MeV neutrons of uranium 238 to plutonium or thorium to uranium 233 for use as a fuel for fission reactors. Breeding fissile fuels has not been a goal of the US fusion energy program. This paper suggests that it is time for a policy change to make the fusion breeder a goal of the fusion program and the nuclear energy program. This paper suggests this policy change be made and tells why it should be made. It outlines specific research and development goals so that the fusion breeder will be developed in time to meet fissile fuel needs.

DOE

N83-29236*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE NASA BROAD-SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM: AN ASSESSMENT OF PHASE 1 TEST RESULTS

J. S. FEAR 1983 13 p refs Presented at the Joint Power Generation Conf., Indianapolis, 25-29 Sep. 1983; sponsored by ASME
 (NASA-TM-83447; E-1753, NAS 1.15:83447) Avail: NTIS HC A02/MF A01 CSCL 21E

An assessment is made of the results of Phase 1 screening testing of current and advanced combustion system concepts using several broadened-properties fuels. The severity of each of several fuels-properties effects on combustor performance or liner life is discussed, as well as design techniques with the potential to offset these adverse effects. The selection of concepts to be pursued in Phase 2 refinement testing is described. This selection takes into account the relative costs and complexities of the concepts, the current outlook on pollutant emissions control, and practical operational problems.

Author

N83-29331# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering
MECHANISMS AND KINETICS OF COAL HYDROGENATION Quarterly Progress Report, Jan. - Mar. 1982

R. M. BALDWIN May 1982 50 p refs
 (Contract DE-AC22-79ET-14881)
 (DE82-016296; DOE/ET-14881/9) Avail: NTIS HC A03/MF A01

When pyrite alone (2g) was employed as the additive, total conversion results were found to be comparable to the case with 2% H₂S and no added pyrite. The increase in conversion at short residence time was again reflected most strongly in the presphalrene fraction. Gas on the reaction products after cooldown showed that H₂S levels were about 0.03% when pyrite alone was the additive, and 0.3% when 2% H₂S was the additive. No H₂S was present in the reactor product gas for the baseline runs (no additives). The effect noted upon addition of pyrite thus may be explained by two entirely different catalytic mechanisms: a heterogeneous catalytic mechanism involving catalysis promoted by reduced pyrite; a homogeneous catalytic mechanism involving catalysis of hydrogen transfer by H₂S released from the hydrogenated pyrite. Pyrite reduction to iron sulfide was previously shown to be very rapid at the temperatures employed.

DOE

N83-29332# Pacific Northwest Lab., Richland, Wash.
PROGRESS IN STUDIES ON CATALYZED GASIFICATION OF WOOD

L. K. MUDGE, E. G. BAKER, R. J. ROBERTUS, and M. D. BROWN 16 Mar. 1983 40 p refs Presented at the 15th Biomass Thermoconversion Contractors' Meeting, Atlanta, 16-17 Mar 1983

(Contract DE-AC06-76RL-01830)
 (DE83-009124; PNL-SA-11190; CONF-830323-1) Avail: NTIS HC A03/MF A01

Technical and economic feasibility of producing specific gas products via the catalytic gasification of biomass was evaluated. Laboratory studies, process development, and economic analyses were performed. The laboratory studies were conducted to develop operating conditions and catalyst systems for generating methane rich gas, synthesis gases, hydrogen, and carbon monoxide and to gain a fundamental understanding of process chemistry. The process development unit (PDU), previously used for tests at atmospheric pressure, was operated at absolute pressures of up to 10 atm (1000 kPa). A program for use on a microcomputer was written to determine the effect of yield changes at elevated pressures on process economics. Results of these studies confirm the favorable economics for generation of methanol from wood. As yet, catalyst life in the PDU was not as long as expected from laboratory studies. Process operations in a large scale fluid bed are technically feasible.

DOE

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N83-29335# Purdue Univ., Lafayette, Ind School of Chemical Engineering.

CO + H SUB 2 REACTIONS OVER NITROGEN-MODIFIED IRON CATALYSTS Quarterly Technical Progress Report, 1 Aug. - 31 Dec. 1982

W N DELGASS 1982 25 p refs

(Contract DE-FG22-82PC-50804)

(DE83-006579; DOE/PC-50804/1) Avail: NTIS HC A02/MF A01

The effects of nitrogen, as nitride and as a gas phase reactant, on hydrocarbon synthesis reactions over iron catalysts was examined. In this first quarterly period of a three year program, two students were assigned to the project and began assimilation of the literature and upgrading of equipment. Initial Mossbauer spectroscopic and kinetic experiments on bulk iron nitrides show our ability to prepare and identify the (BETA) prime-Fe₄N phase and follows its stability during Fischer-Tropsch synthesis. Kinetic and characterization experiments is the major emphasis of this first phase of the work. DOE

N83-29337# Sandia Labs., Albuquerque, N Mex.

RELATIVE CATALYTIC ACTIVITY OF IRON CONTAINING MINERALS FOR THE HYDROGASIFICATION OF COAL

T. D. PADRICK, J. K. RICE, and T. M. MASSIS 1982 7 p refs Presented at the Am. Chem Soc Symp. on Coal Liquefaction, Kansas City, Mo, 1 Sep 1982

(Contract DE-AC04-76DP-00789)

(DE82-012776; SAND-82-0642C, CONF-820909-3) Avail: NTIS HC A02/MF A01

Investigation of the catalytic activity of several iron compounds on hydrogasification of coal showed that catalytic activity is dependent on the particular iron compound with the following order observed: Fe₂O₃ Fe₃O₄ FeSO₄ FeS₂ FeO Fe Results of two series of experiments performed to aid in interpreting this dependence of reduced iron catalytic activity on precursor species are described. The assumption was made that the role of reduced iron in catalyzing hydrogasification is dissociation of H₂. Also, there was evidence that catalysts affected gasification by physical interaction with the coal Hydrogen transfer activity of the reduced iron state for six iron containing minerals were measured. Each mineral resulted in a different active site density The nitrogen BET surface area and total pore volume on coal char samples with added iron containing minerals were measured Again, each mineral affected the physical structure of the char differently. DOE

N83-29339# Oak Ridge National Lab., Tenn.

INTERNATIONAL SURVEY OF THE STATUS OF TECHNOLOGY OF CRITICAL COMPONENTS FOR COAL-LIQUEFACTION PROCESSES

W. R. WILLIAMS, T. B. CONLEY, T. L. DAHL, and K. O. JOHNSON Jun. 1982 78 p

(Contract W-7405-ENG-26)

(DE82-015236; ORNL/ENG-EM-24) Avail: NTIS HC A05/MF A01

The subject survey considers three categories of components: slurry letdown valves, slurry pumps, and heat transfer equipment (slurry preheaters and exchangers and gasifier waste heat boilers). Foreign technology is similar to US technology and that both foreign and domestic manufacturers are hindered by: (1) a lack of adequate design correlations partially because of proprietary restrictions; and (2) uncertainties in demonstration and commercialization schedules Solutions to slurry letdown valve and slurry pump problems, which are only now being developed in the United States, were used as far back as the 1940s in German liquefaction plants and today are being incorporated into equipment selected and installed in several foreign pilot plants. DOE

N83-29343# California Univ., Berkeley Lawrence Berkeley Lab Energy and Environment Div.

METAL COORDINATION CHEMISTRY: REMOVAL AND RECOVERY OF METAL COMPOUNDS FROM HEAVY CRUDE AND SHALE OILS WITH MULTIDENTATE LIGANDS Annual Report, Oct. 1981 - Oct. 1982

R. H. FISH Dec 1982 140 p refs

(Contract DE-AC03-76SF-00098)

(DE83-006912, LBL-15398) Avail: NTIS HC A07/MF A01

Progress reports are presented for the following tasks: (1) speciation of inorganic and organoarsenic compounds in retort waters, shale oil and Green River Formation oil shale, (2) synthesis of organoarsenic and inorganic arsenic catecholates as models for removal of organoarsenic and inorganic arsenic compounds from retort recovery products such as shale oil and retort water; (3) preparation of polymer bonded catechols for reaction studies with organoarsenic and inorganic arsenic compounds; (4) molecular characterization and fingerprinting of vanadyl porphyrin and nonporphyrin compounds found in various heavy crude petroleum and their asphaltene; (5) synthesis of model vanadyl non-porphyrin compounds for comparison to those found in various heavy crude petroleum. In addition, 16 papers presented at meetings during 1980 to 1982, and 75 papers published during 1981 to 1982 are listed. DOE

N83-29350# Colorado School of Mines, Golden

LIQUID-VAPOR EQUILIBRIA FOR TERNARY NATURAL GAS SYSTEMS Annual Report, Sep. 1981 - Sep. 1982

A. J. KIDNAY and E. D. SLOAN Oct 1982 83 p refs

Sponsored by Gas Research Inst.

(PB83-173419; GRI-83-0001) Avail: NTIS HC A05/MF A01

CSCL 07D

Vapor-liquid equilibria were measured for the binary systems methane + carbon dioxide at 230, 250 and 270 K; methane + ethane at 210, 230, 250 and 270 K, and ethane + carbon dioxide at 210, 213, 230 and 250 K. The ternary system methane + ethane + carbon dioxide was studied at 230 K over the pressure range 1.15 MPa to 6.59 MPa The Peng-Robinson equation of state was used to model the experimental data with an accuracy sufficient for most engineering calculations Preliminary studies were made of the solid-liquid-vapor equilibria for the binary systems methane + carbon dioxide and ethane + carbon dioxide GRA

N83-29353# Central Inst. for Industrial Research, Oslo. (Norway).

SUPERACIDS AS CATALYSTS FOR SELECTED HYDROCARBON CONVERSIONS

E. B. OFSTAD Feb. 1983 57 p refs Transl. into ENGLISH of "Supersyrer som Katalysatorer for Utvalgte Hydrokarbonreaksjoner" Norway, Mar. 1982 43 p

(PB83-166546, REPT-81-03-08-4) Avail: NTIS HC A04/MF A01

CSCL 07D

Liquid and solid superacids and their use as catalysts for selected hydrocarbon conversions are described. Reaction mechanisms are outlined, and literature data concerning reaction rate, conversion, selectivity, product composition, etc., is referred The reaction types mainly considered are those of greatest importance for future chemical industrial utilization of natural gas, i.e., reactions involving light alkanes. GRA

N83-29359*# Southwest Research Inst., San Antonio, Tex.

EVALUATION OF FUEL ADDITIVES FOR REDUCTION OF MATERIAL INCOMPATIBILITIES IN METHANOL-GASOLINE BLENDS Final Report

C. F. RODRIGUEZ, J. G. BARBEE, W. K. KNUTSON, and J. P. CUELLAR, JR. Mar. 1983 41 p refs

(Contract DEN3-287; DE-A101-81CS-50006)

(NASA-CR-168061; DOE/NASA/0287-1, NAS 1.26:168061,

SWRI-7080) Avail: NTIS HC A03/MF A01 CSCL 11F

Screening tests determined the efficacy of six commercially available additives as modifiers of methanol's corrosivity toward metals and its weakening of tensile properties of nonmetals in automotive fuel systems. From the screening phase, three additives

which seemed to protect some of the metals were tested in higher concentrations and binary combinations in search of optimal application conditions. Results indicate that two of the additives have protective properties and combining them increases the protection of the metals corroded by methanol-gasoline blends. Half of the metals in the tests were not corroded. Testing at recommended concentrations and then at higher concentrations and in combinations shows that the additives would have no protective or harmful effects on the nonmetals. Two additives emerged as candidates for application to the protection of metals in automotive methanol-gasoline fuel systems. The additives tested were assigned letter codes to protect their proprietary nature.

A.R.H.

N83-29414# Cranfield Inst of Tech., Bedfordshire (England). Management Library.

ALTERNATIVE FUEL TECHNOLOGY SERIES. VOLUME 1: ALTERNATIVE FUELS FOR TRANSPORT

E. M. GOODGER 1982 38 p refs

(ISBN-0-902937-63-4) Avail. NTIS HC A03/MF A01

The fuels that are proposed as candidates for conventional fuel extenders or substitutes in the three main branches of transport surface, marine and air are reviewed. Summaries of short courses that were held on this subject together with lists of references to student research theses and dissertations, and related publications are presented.

S.L.

N83-29418# Transco Products, Inc., Arcadia, Calif.

TRANSOCO MEDIUM-BTU COAL GASIFICATION PROJECT. EXECUTIVE SUMMARY Final Report

Mar. 1982 20 p refs

(Contract DE-FG01-81RA-50381)

(DE82-009598; DOE/RA-50381/1156-EXEC-SUMM) Avail

NTIS HC A02/MF A01

The feasibility study preliminary design demonstrates the ability to design a gasification facility capable of producing 125 MMBtu/day of medium btu gas in central Texas adjacent to a lignite resource. The lignite resource selected is acceptable for the proposal with regard to geology, mine plan and lignite quality. The economic and financial analyses identified three key aspects of the project. The basic assumptions presented in the financial analysis are realized, product gas can be delivered at a minimum real price which is higher than current regulated prices for natural gas the most logical alternatives for the proposed customer; in order to raise the amount of debt required to finance the project, either a substantial consortium of partners or some type of loan guarantee, such as from the Synthetic Fuels Corporation, would be required. Improvements in several key variables could enhance the project economics significantly.

DOE

N83-29423# Merx Corp., Babson Park, Mass

ALCOHOL-FUELS GRANT PROGRAM. LOW-ENERGY ROUTE FOR ALCOHOL/GASOLINE RECOVERY FROM FERMENTOR BEER Final Report

T. W. MIX 1 Jan 1983 40 p refs

(Contract FG07-81ID-12321)

(DE83-009665; DOE/ID-12321/T1) Avail NTIS HC A03/MF A01

The production of gasohol directly from fermentor beer and gasoline is feasible and will enable a major reduction in the energy requirements for gasohol production. The fermentor beer is first enriched in a beer still to a 69 mol % ethanol, 31 mol % water product which is then dehydrated by extractive distillation with gasoline as the extractive agent. Gasohol is produced directly in one version of the process, a heavy cut of gasoline, presumed available at a refinery before blending in of light components, is used as the extractive agent. The enriching column overhead vapors are used to reboil the extractive distillation and a steam stripping columns and to contribute to the preheating of the fermentor beer feed. Light components are blended into the heavy cut-ethanol bottom product from the extractive distillation column to form the desired gasohol. Energy requirements, including feed preheat, are 11,000 Btu per gallon of ethanol in the product

gasohol. One hundred and fifty pound steam is required. In a second version, full range gasoline is used as the extractive agent.

DOE

N83-29431# Tri-State Synfuels Co., Houston, Tex.

TRI-STATE SYNFUELS PROJECT COMMERCIAL SCALE COAL TEST. VOLUME 2A: COLLECTION AND SHIPMENT MINE, BARGE, SHIP AND TRAIN PROGRAMS

Jun. 1982 268 p

(Contract DE-FC05-81OR-20807)

(DE83-007443; DOE/OR-20807/T1-VOL-2A) Avail. NTIS HC A12/MF A01

The collection of Camp 1 coal at the mine in Morganfield, Kentucky and shipment of the sample to Sasolburg, Republic of South Africa is covered. The collection and shipment phase covers the inspection, sampling, preparation and analytical testwork on coal quality and size for the mine, barge, ship and train programs. The samples tested were taken at the following locations: Morganfield and Uniontown, Kentucky; Darrow, Louisiana; and Port Elizabeth and Sasolburg, Republic of South Africa. The analytical program involved complete sieve and physical/chemical characterization of the total sample and coarse and fine fractions, including ASTM and RCRA leaching tests. The coal was dry screened at 1/4-inch round hole size to simulate gasifier feed quality and boiler feed quality. A representative portion of the shipment coal was taken to build up a 200-ton stockpile simulating dead storage at Uniontown for purposes of monthly oxidation or weathering and leaching tests for one year duration.

DOE

N83-29433# Tri-State Synfuels Co., Houston, Tex.

COMMERCIAL SCALE COAL TEST. VOLUME 4: COAL FINES UTILIZATION IN FURNACE BOILERS

Jun 1983 41 p

(Contract DE-FC05-81OR-20807)

(DE83-007450; DOE/OR-20807/T1-VOL-4) Avail NTIS HC A03/MF A01

Technical feasibility of coal fines utilization as a boiler fuel in both cyclone and pulverized fuel furnace boilers was examined. The fines examined were representative of the fine fraction of the Camp 1 coal shipment to Republic of South Africa for the commercial scale gasification test. The Camp 1 coal also was selected as the Tri-State Synfuels design coal and as such the sample was characterized both for gasification (coarse fraction) use as well as boiler (fine fraction) use, not only for in-plant steam and power but also for export to nearby potential users. Paul Weir concluded that the Camp 1 raw fines or washed fines are suitable as a potential fuel source in cyclone (wet bottom) and pulverized (dry bottom) furnaces. Paul Weir also identified several provisions that should be considered for the design of the storage, handling and transportation systems for the fine coal due to the ability of the coal to retain moisture.

DOE

N83-29434# Chem Systems, Inc., Fairfield, N.J. Research and Development Group

DEVELOPMENT OF ALCOHOL-BASED SYNTHETIC TRANSPORTATION FUELS FROM COAL-DERIVED SYNTHESIS GASES Final Technical Report, Sep. 1979 - Jul. 1982

15 Dec 1982 356 p refs

(Contract DE-AC22-79ET-14858)

(DE83-004857; DOE/ET-14858/T2) Avail. NTIS HC A16/MF A01

Chem Systems, Inc. has completed a two-year R and D program formulated to develop catalysts and a reaction system for the conversion of coal derived synthesis gases to alcohol based, synthetic transportation fuels. A four-task approach which included a catalyst formulation and screening phase, a process variables evaluation phase utilizing laboratory-scale and bench-scale reactors, and a technical and economic analysis phase were designed. The major accomplishments and conclusions achieved during the course of the program are summarized below: ALKANOL fuels, containing mixtures of methanol and C2-C6 saturated alcohols, represent a means of incorporating methanol into the gasoline pool while simultaneously circumventing most of the

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technical problems associated with the use of neat methanol gasoline blends. Preferred catalysts and reaction conditions were identified for the conversion of simulated coal derived synthesis gases to ALKANOLS at high selectivity. DOE

N83-29435# Tri-State Synfuels Co., Houston, Tex.
COMMERCIAL SCALE COAL TEST. VOLUME 1: SELECTION OF CAMP 1 COAL

Jun. 1982 135 p
(Contract DE-FC05-81OR-20807)
(DE83-007436; DOE/OR-20807/T1-VOL-1) Avail: NTIS HC A07/MF A01

Camp 1 coal was selected for a commercial scale gasification test conducted at the Sasol One Plant. The initial coal quality evaluation consisted primarily of The Pennsylvania State University coal data from Illinois Basin Counties. A preliminary collection of Illinois Basin coal quality data was developed to support the selection of coals for potential plant supply and full scale commercial testing. The total sample and coarse and fine fractions were analyzed. The list of potential source mines for the 22,000 short ton sample of raw coal for the test was narrowed to three. The mines were Camp 1, Ken and Providence. Paul Weir Company examined the data and recommended Camp 1 mine since it operates in the seams contiguous to other potential candidate reserve sites and has the ability to transport the mine sample by belt to a barge loading facility to limit production of fines DOE

N83-29437# Office of Technology Assessment, Washington, D.C.

INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS. ALTERNATIVES FOR REDUCING OIL IMPORTS. BACKGROUND PAPER 5: WATER AVAILABILITY FOR SYNTHETIC FUELS: AN ASSESSMENT OF CURRENT STUDIES

Oct. 1982 151 p refs
(PB83-152645) Avail: NTIS HC A08/MF A01 CSCL 21D

The hydrologic, institutional, legal, and economic issues involved in assessing and interpreting estimates of water availability for synfuels development in four major river basins: (1) Upper Mississippi, (2) Ohio/Tennessee, (3) Upper Missouri, and (4) Upper Colorado were described and analyzed GRA

N83-29438# General Electric Co., Philadelphia, Pa.
MARINE BIOMASS PROGRAM: KELP BIOMASS PROGRAM SUMMARY Final Annual Report, Sep. 1980 - Dec. 1981

A. N. TOMPKINS Apr. 1982 511 p Prepared in cooperation with Midwest Research Inst.
(PB83-167247; GRI-81-0118) Avail: NTIS HC A22/MF A01 CSCL 21D

Details of the research and development activities undertaken by the General Electric Company and its team of associates for the Solar Energy Research Institute and the Gas Research Institute are provided. The primary objective at the start of work in September 1980 was to provide data necessary to evaluate the technical and economic feasibility of concepts for producing methane from giant California brown kelp cultivated in the ocean waters off the Coast of Southern California. Simultaneously, plans were developed for laboratory and field experiments in kelp biology designed to support these yield studies, as well as plans for continuing the studies of anaerobic digestion process development. As a result of early 1981 program evaluation, the program sponsors decided in May that the work should be directed toward the acquisition of yield data in alternative nearshore test facilities. Project activities were then realigned towards development of two nearshore test facilities from which harvestable yield data will be obtained. GRA

N83-29439# Office of Technology Assessment, Washington, D.C.

INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS. ALTERNATIVES FOR REDUCING OIL IMPORTS. BACKGROUND PAPER NUMBER 3: ENVIRONMENTAL ISSUES OF SYNTHETIC TRANSPORTATION FUELS FROM COAL

Nov 1982 114 p refs
(PB83-161851) Avail: NTIS HC A06/MF A01 CSCL 21D

Environmental impacts from large scale commercialization of coal liquefaction are important to government, industry, the public, and a variety of interest groups. Environmental issues associated with coal liquefaction processes are reviewed by addressing the following topics: a comparison of the environmental differences among technologies; a comparison of the impacts among different coal regions, a description of the uncertainty of synfuels data and environmental effects, and an identification of problems aggravated by accelerated development schedules GRA

N83-29440# Office of Technology Assessment, Washington, D.C.

INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS: ALTERNATIVES FOR REDUCING OIL IMPORTS. BACKGROUND PAPER NUMBER 4: ENVIRONMENTAL ISSUES OF SYNTHETIC TRANSPORTATION FUELS FROM COAL

Dec. 1982 214 p refs
(PB83-161919) Avail: NTIS HC A10/MF A01 CSCL 21D

A state of the art review of the environmental problems, including: a comparison of environmental differences among competing synfuels technologies; an evaluation of the environmental differences between strict and lenient levels of control; an identification of impacts aggravated by accelerated development; a comparison of significant differences in impacts among coal-producing regions; and a description of the uncertainty of synthetic fuels environmental data and environmental effects is provided. The processing and end-use phases of coal liquefaction technology to produce transportation fuels during the next several decades is emphasized. GRA

N83-29443# International Harvester Co., Hinsdale, Ill.
METHANOL FROM LANDFILL GAS: TECHNOLOGY AND ECONOMICS Final Report

J. B. HOLLomon Albany, N.Y. New York State Energy Research and Development Authority Dec. 1982 82 p refs
(PB83-169144; NYSERDA-82-24, REPT-432-ET-FUC-82) Avail: NTIS HC A05/MF A01 CSCL 21D

The study consists of a detailed conceptual process design for an integrated facility, including cost estimates and financial analysis; the results of a laboratory investigation of the composition of gas from the Fresh Kills landfill on Staten Island, and a market analysis of potential methanol uses and plant sites in New York State. The conditions under which operation of a methanol plant would be economical are addressed, as well as strategies for introducing methanol into the marketplace. In addition, the details on the extensive chemical data developed during the project concerning contaminants which might affect process performance or economics are included. GRA

N83-29444# Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.

DEVELOPMENT OF IMPROVED CAPABILITIES FOR COMPUTATION OF GAS SUPERCOMPRESSIBILITY FACTORS AND OTHER PROPERTIES Annual Report, Jul. 1981 - Jun. 1982

K. E. STARLING, K. H. KUMAR, J. L. SAVIDGE, M. A. GHANNUDI, M. ABREU, B. ECKHARDT, J. L. TATEYA, R. HISLE, J. SELVIDGE, and W. BECRAFT Chicago Gas Research Inst. Jul. 1982 52 p refs Sponsored by Gas Research Inst.
(PB83-173369; GRI-81-0097) Avail: NTIS HC A04/MF A01 CSCL 21D

Research carried out during the first year of a three year project to develop improved capabilities for the computation of gas

supercompressibility factors and other properties for the gas industry is reported. An evaluation of the present methods of gas supercompressibility factor calculations in the U.S. gas industry was made. This study points out the need for the development of a new supercompressibility factor correlation. An elaborate literature search was conducted to collect pertinent available experimental data and then these data were processed into a computer data bank. An evaluation of the collected data for the major components of natural gas indicated the need for more accurate data and also for new data. A document reviewing the project objectives, the correlation methodology to provide the rationale for the data needed, a review of the available data for first priority level systems, the actual data needs, and the temperature, pressure and composition ranges was prepared. Initial efforts on the correlation development are also reported herein. GRA

N83-29445# Pennsylvania State Univ., University Park.
IMPORTANCE OF ACTIVE SITES FOR CHAR GASIFICATION IN OXYGEN (AIR) AND CARBON DIOXIDE Final Report, Oct. 1979 - Sep. 1982

P. L. WALKER, JR., R. G. JENKINS, and L. R. RADOVIC
Chicago Gas Research Inst. Oct 1982 284 p refs Sponsored by Gas Research Inst.
(PB83-173393; GRI-82-0024) Avail: NTIS HC A13/MF A01
CSCL 21D

The fundamental parameters that determine char reactivity were investigated. Chars were prepared from raw and pretreated lignite under widely varying conditions of pyrolysis heating rate, temperature and residence time. The gasification reactivity of the chars was determined by isothermal thermogravimetric analysis, mostly in 0.1 MPa air, but also in 0.1 MPa CO₂ and 3.1 kPa H₂O. A detailed analysis of the surface properties of the chars was performed. A very wide range of reactivities of the chars was achieved by varying the conditions of pyrolysis and pretreatment of the lignite. The commonly observed and heretofore empirically treated coal char deactivation with increasing severity of pyrolysis conditions was correlated with a decrease in measurable fundamental properties of the chars. GRA

N83-29715# United Technologies Corp., South Windsor, Conn.
Power Systems Div.

EVALUATION OF SYNTHETIC-FUEL-CHARACTER EFFECTS ON RICH-LEAN STATIONARY-GAS-TURBINE COMBUSTION SYSTEMS. VOLUME 1: SUBSCALE TEST PROGRAM Final Report

T. J. ROSFJORD Feb. 1983 85 p refs
(Contract EPRI PROJ. 1898-1)
(DE83-901452; EPRI-AP-2822-VOL-1) Avail: NTIS HC A05/MF A01

The evaluation of synthetic fuel character effects on rich lean stationary gas turbine combustion systems is described. Five fuels, including No. 2 petroleum distillate fuel, SRC 2, H-coal, and EDS middle distillates and hydrotreated Paraho shale oil residual were tested in a subscale 5-inch diameter rich burn/quick quench staged rich lean combustor at conditions representative of peak, baseload, part power and off design ratings of a 30 MW industrial gas turbine. This combustor is based on the design evolved under which the rich burn/quick quench concept was developed. The fuel property data base was expanded, and the range of operating conditions were extended. A minimum NO/sub X/ emission level correlated to 15% oxygen of approximately 37 ppm (well below EPA limits) was attained for all of the fuels despite fuel bound nitrogen (FBN) levels of up to 0.75% by weight. Sensitivity of NO/sub x/ emissions to reduce rich zone residence time was found to be very small. The combustor smoke emissions at baseload conditions depended on fuel properties and ranged between an SAE Smoke Number of 15 to 45. A test with improved fuel preparation resulted in a dramatic reduction in smoke with shale oil residual fuel from an SAE Smoke Number of 40 to 3. DOE

N83-29716# Los Alamos Scientific Lab., N. Mex.
OPERATING EXPERIENCE WITH A LIQUID-HYDROGEN FUELED BUICK AND REFUELING SYSTEM

W. F. STEWART 1982 42 p refs Presented at the World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982
(Contract W-7405-ENG-36)
(DE82-008113; LA-UR-82-428; CONF-820605-8) Avail: NTIS
HC A03/MF A01

An investigation of liquid hydrogen storage and refueling systems for vehicular applications was made. The vehicle used in the project was a 1979 Buick Century sedan with a 3.8-L displacement turbocharged V6 engine and an automobile transmission. The vehicle had a fuel economy for driving in the high altitude Los Alamos area that was equivalent to 2.4 km/L of liquid hydrogen or 8.9 km/L of gasoline on an equivalent energy basis. About 22% less energy was required using hydrogen rather than gasoline to go a given distance based on the Environmental Protection Agency estimate of 7.2 km/L of gasoline for this vehicle. At the end of the project the engine had operated for 138 h and the car driven 3633 km during the 17 months that the vehicle was operated on hydrogen. DOE

N83-29719# Foster-Miller Associates, Inc., Waltham, Mass.

DIESEL EXHAUST-GAS PURIFICATION SYSTEM

B. J. DOHERTY Jul. 1982 63 p refs
(Contract DE-AC04-76DP-00789)
(DE82-019808; SAND-82-7027) Avail: NTIS HC A04/MF A01

The design of a diesel exhaust gas purification system is presented. It will provide 2000 scfm of dry, anoxic gas (essentially nitrogen) for use in air drilling operations where drill pipe corrosion is a problem, such as geothermal applications. The system is operable in the field and may be transported via highways. It will operate at ambient temperatures up to 110 F and requires no water diesel fuel is used to combust excess oxygen and to generate electricity for the system. Gas production costs, including capital amortization, operations, fuel and maintenance (for reasonable utilization) are about \$1 50/100 scf. DOE

N83-29721# Environmental Protection Agency, Ann Arbor, Mich.
Control Technology Assessment and Characterization Branch.

ANALYSIS OF IN-USE FUEL ECONOMY DATA, STAGE 1

Aug. 1982 359 p
(PB83-144162; EPA/AA/CTAB/FE/82-6) Avail: NTIS HC
A17/MF A01 CSCL 13F

The need for, and the background work done on adjusting the Environmental Protection Agency (EPA) miles per gallon (MPG) values to more closely correspond to actual fuel economy experience on the road are summarized. The derivation of mathematical algorithms that could be used to perform the needed adjustment is emphasized. Using an extensive data base of in-use fuel economy, algorithms are developed which depend on certain design features of motor vehicles. Substantial improvements in the accuracy of the fuel economy labeling and gas mileage programs will result when adjustments to the values are adopted. GRA

N83-29722# Southwest Research Inst., San Antonio, Tex.
EMISSION CHARACTERIZATION OF A SPARK-IGNITED, HEAVY-DUTY, DIRECT-INJECTED METHANOL ENGINE Final Report, Dec. 1981 - May 1982

T. L. ULLMAN and C. T. HARE Ann Arbor, Mich. EPA Nov. 1982 128 p refs
(Contract EPA-68-03-3073)
(PB83-156372; EPA-460/3-82-003) Avail: NTIS HC A07/MF
A01 CSCL 21G

A truck size diesel engine was modified to consume only neat methanol by the addition of a transistorized spark ignition system. Regulated and unregulated exhaust emissions from this methanol engine with oxidation catalyst were characterized. Emissions characterization included regulated emissions (HC, CO, and NO_x), along with unburned alcohols, aldehydes, other gaseous organics, total particulate, sulfate, soluble organic in particulate, BaP, and Ames bioactivity. Emissions from this spark ignited methanol and

04 FUELS AND OTHER SOURCES OF ENERGY

catalyst engine are compared to emissions from a pilot injected methanol engine and a comparable diesel engine GRA

N83-29786# Kansas Univ., Lawrence.
ASSESSMENT OF THE GEOTHERMAL RESOURCES OF KANSAS. VOLUME 2, SECTION 2: APPENDICES
Jun. 1982 55 p
(Contract DE-AS07-79ET-27204)
(DE83-003221; DOE/ET-27204/T1-VOL-2-SECT-2) Avail. NTIS HC A04/MF A01

Regression analyses of thermal logging data, usable and non-usable, for 1980 and 1981 is given. DOE

N83-29789# Department of Energy, Washington, D. C. Office of Coal, Nuclear, Electric and Alternate Fuels
DEMONSTRATED RESERVE BASE OF COAL IN THE UNITED STATES ON 1 JANUARY 1980
May 1982 40 p refs
(DE83-006471; DOE/EIA-0280(80)) Avail. NTIS HC A03/MF A01

This is the second in a series of annual summaries on minable coal in the United States, pursuant to the power plant and industrial fuel use act. The demonstrated reserve base of coal in the United States on January 1, 1980 by area, rank, and potential method of mining is given. Reserve data are given by state and by type of coal (anthracite, bituminous, subbituminous, and lignite). An introduction, summary, and a glossary of selected coal classification terms is also included. The appendix provides the demonstrated reserves base adjustments and related notations by state. References are also included. Coal reserves for 1979 are given for comparison. 7 figures, 6 tables DOE

N83-29790# Utah Geological and Mineralogical Survey, Salt Lake City
EVALUATION OF LOW-TEMPERATURE GEOTHERMAL POTENTIAL IN CACHE VALLEY, UTAH M.S. Thesis
J. L. DEVRIES and R. H. KLAUK Nov 1982 112 p refs
(Contract DE-AS07-77ET-28393; EG-77-5-7-1679)
(DE83-001219; DOE/ET-28393/T1) Avail. NTIS HC A06/MF A01

Some 90 wells and springs were located and water samples were collected. Thermal gradients were approximately the same as the average for the Basin and Range province, about 350 C/km. One well produced a gradient of 2970 C/km, most probably as a result of a near-surface occurrence of warm water. Possible warm water reservoir temperatures were calculated using both the silica and the Na-K-Ca geothermometers, with the results averaging about 50 to 1000 C. If mixing calculations were applied, taking into account the temperatures and silica contents of both warm springs or wells and the cold groundwater, reservoir temperatures up to about 2000 C were indicated. Considering measured surface water temperatures, calculated reservoir temperatures, thermal gradients, and the local geology, most of the Cache Valley, Utah area is unsuited for geothermal development. However, the areas of North Logan, Benson, and Trenton were found to have anomalously warm groundwater in comparison to the background temperature of 1300 C for the study area. The warm water has potential for isolated energy development but is not warm enough for major commercial development. DOE

N83-29836# Geological Survey, Denver, Colo.
GEOTHERMAL-RESERVOIR ASSESSMENT AND CONFIRMATION PROGRAM FOR DIRECT-HEAT APPLICATIONS IN COLORADO Final Technical Report
R. H. PEARL Feb. 1983 27 p refs
(Contract DE-AS07-77ET-28365; EG-77-C-07-1678)
(DE83-009816; DOE/ET-28365/27) Avail. NTIS HC A03/MF A01

The project description, required research project personnel, an annotated list of reports, and problems and recommendations are included. DOE

N83-29848# Ohio State Univ., Columbus
FINITE-ELEMENT MODELING OF THERMO-MECHANICAL RESPONSES ASSOCIATED WITH UNDERGROUND COAL CONVERSION

O. K. MIN Feb 1983 288 p refs
(Contract DE-AS20-80LC-10335; DE-AS20-80LC-10886)
(DE83-006748; DOE/LC-10335/T1) Avail. NTIS HC A13/MF A01

The in situ gasification of coal has received increased international attention. Several technical, environmental, safety, and economic considerations were indicated as potential advantages. The controlled extraction of this resource requires laboratory experiments, mathematical modeling, and field tests. The prediction of temperature, stress and gasification chamber configuration is a prerequisite in evaluating process mechanisms, roof collapse, combustion stability, and optimization of commercial projects. The thermomechanical response is obtained by using the finite element method. The energy generated by the coal combustion at the burn front is quantitatively introduced in the heat conduction equation. The gasification chamber configuration is defined by an assumed reference front isotherm. Thermoelastic and thermoplastic constitutive relations along with failure criteria are used in predicting the failure fronts. The incorporation of the burn front propagation and the collapse of failed overburden determines the chamber configuration. DOE

N83-29851# Sandia Labs., Albuquerque, N. Mex. Enhanced Oil Recovery Div.
CONCEPTUAL DESIGN OF A DIRECT-CONTACT NATURAL-GAS-FIRED DOWNHOLE STEAM GENERATOR
J. B. MORENO Jun. 1982 65 p refs
(Contract DE-AC04-76DP-00789)
(DE82-019875; SAND-82-0715) Avail. NTIS HC A04/MF A01

Conceptual designs are presented for three natural gas fueled, 1500 to 2000 psi, downhole steam generators: a 4 MMBtu/h unit sized for 7-inch casing, an 18.4 MMBtu/h unit sized for 7-inch casing, and an 18.4 MMBtu/h unit sized for 9-5/8 inch casing. Specifications for the support systems for each system are outlined, considering both 3650-foot and 7000-foot well depths. Costs for major components and confidence levels for each design are estimated. Design philosophy and procedures are given in sufficient detail to enable extrapolation of or interpolation between the three designs. DOE

N83-29869# Kraftwerk Union A.G. Reaktortechnik, Erlangen (West Germany). Hauptbereich Vertrieb und Kraftwerkstechnik
INCREASING THE EFFICIENCY OF COAL-FIRED POWER PLANTS BY MEANS OF A TRANSITION TO MAXIMUM STEAM CONDITIONS Final Report, Mar. 1981
G. AURIN and L. STADIE Bonn Bundesministerium fuer Forschung und Technologie Apr. 1983 208 p refs. In GERMAN, ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-83-033; ISSN-0340-7608) Avail. NTIS HC A10/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 36,50

The economic effectiveness of coal-fired power plants working under maximum steam conditions and the technical feasibility of large outputs were studied. The design data for components exposed to high thermal and compressive stresses were determined. It was demonstrated that hard-coal-fired power plants with a rating up to 1000 MW and maximum steam conditions of 300 bar/600 C are technically feasible. The weldability, the manufacture of shaped parts and the testability of piping systems constitute the limits of technical feasibility. Application in the base load range provides an economic incentive for the construction of power plants of this kind. But in medium load range hard coal power plants, this advantage is not practical in this operating mode, the start-up times and rates of load change must be given greater consideration, due to the high steam conditions. Author (ESA)

ENERGY CONVERSION

N83-29907# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Science Div.

CORRELATION BETWEEN PRECISION GRAVITY AND SUBSIDENCE MEASUREMENTS AT CERRO PRIETO

R. ZELWER and R. B. GRANNELL (California State Univ.) Oct. 1982 9 p refs Presented at the 4th Symp. on the Cerro Prieto Geothermal Field, Guadalajara, Mexico, 10-12 Aug. 1982 Sponsored in part by the Comision Federal de Electricidad (Contract DE-AC03-76SF-00098) (DE83-005870; LBL-14894; CONF-8208109-2; CP-22; EDB-150600) Avail: NTIS HC A02/MF A01

Precision gravity measurements were made in the region of the Cerro Prieto geothermal field at yearly intervals from 1977 to 1981 to assess the feasibility of using gravity to determine subsurface reservoir changes with time. The extent of mass recharge in response to the continued production of fluids from this field was studied. Changes in gravity and ground elevation were observed throughout the region for the period of observation. Results indicate that the largest changes observed were the result of the Magnitude 6.1 (Caltech) Victoria earthquake of 8 June 1980. The epicenter of this earthquake was located 25 km southeast of the field on the Cerro Prieto Fault, which bounds the field on the southwest. Subsidence of up to 55 cm was measured east of the power plant, in the region between the northern end of the Cerro Prieto Fault and the southern end of the Imperial Fault. This area has been postulated to be the site of an active spreading center or pull-apart basin, and has been characterized by a high level of seismic activity during the last 10 years. DOE

N83-29957# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab.

A NUMERICAL MODEL FOR WIND-WAVE PREDICTION IN DEEP WATER Final Report

D. T. RESIO and B. A. TRACY Jan 1983 71 p refs (AD-A125985; WIS-12) Avail: NTIS HC A04/MF A01 CSCL 08C

This report contains a description and listing of a numerical wave hindcast model similar to that used to calculate 20 years of wave conditions in the Atlantic Ocean as part of the Wave Information Study. For a specified spatial grid, the model takes input time sequences of wind velocity and calculates the directional wave spectrum from which parameters such as significant wave height, frequency of peak energy density, and mean wave direction can be deduced. Instructions on how to set up the input and output for the model are given and a discussion of the model's limitations is provided. Author (GRA)

N83-30218# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.

COMMERCIAL HIGH-LEVEL-WASTE MANAGEMENT: OPTIONS AND ECONOMICS. A COMPARATIVE ANALYSIS OF THE CERAMIC AND GLASS WASTE FORMS

R. L. MCKISSON, L. F. GRANTHAM, J. GUON, and H. L. RECHT 25 Feb. 1983 133 p refs (Contract DE-AC09-79ET-41900) (DE83-006235; DOE/ET-41900/17; ESG-DOE-13391) Avail: NTIS HC A07/MF A01

Results of an estimate of the waste management costs of the commercial high level waste from a 3000 metric ton per year reprocessing plant show that the judicious use of the ceramic waste form can save about \$2 billion during a 20 year operating campaign relative to the use of the glass waste form. This assumes PWR fuel is processed and the waste is encapsulated in 0.305-m-diam canisters with ultimate emplacement in a BWIP-type horizontal-borehole repository. Waste loading and waste form density are the driving factors in that the low waste loading (25%) and relatively low density (3.1 g cu cm) characteristic of the glass form require several times as many canisters to handle a given waste throughput than is needed for the ceramic waste form whose waste loading capability exceeds 60% and whose waste density is nominally 5.2 cu cm. DOE

Includes thermomechanical, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors, magnetohydrodynamic generators, and fuel cells.

A83-30150#

LINEAR AND NONLINEAR INSTABILITY THEORY OF A NOBLE GAS MHD GENERATOR

A. J. MESLAND Eindhoven, Technische Hogeschool, Doctor in de technische Wetenschappen Thesis, 1982, 165 p. Research supported by the Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek and EURATOM. refs

The stability of the working medium of a seeded noble gas magnetohydrodynamic generator is studied. The aim of the investigation is to determine the instability mechanism which is most likely to occur in experimental MHD generators and to describe its behavior with linear and nonlinear theories. The pertinent macroscopic basic equations are derived, and a linear plane wave analysis of small disturbances of a homogeneous steady state is presented. The electrothermal instability appears to be the most likely one to affect the performance of noble gas MHD generators. Three relevant approximations are used to discuss its properties. The steady state is discussed and a nonlinear plane wave model of the electrothermal instability based on the results of the linear plane wave theory is introduced. The problem is described by a system of two ordinary differential equations. The correspondence between linear and nonlinear theory is shown and neutrally stable situations are discussed. The nonlinear growth of disturbances and their saturation are determined, and the differences from the linear plane wave theory are considered. C.D.

A83-30188#

POLARIZATION AND SIDEWALL EFFECTS IN A COAL-FIRED MHD CHANNEL

M. H. SCOTT, Y. C. L. WU (Tennessee, University, Tullahoma, TN), and M. ISHIKAWA Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 204-210 refs (Contract DE-AC02-79ET-10815)

Previously cited in issue 17, p. 3015, Accession no. A81-39007

A83-30189#

MHD PSEUDOSHOCK AND QUALITATIVE MODEL IN THE PERFORMANCE OF SUPERSONIC GENERATORS

P.-C. LU and K.-H. WANG (Nebraska, University, Lincoln, NE) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 211-217. refs (Contract AF-AFOSR-79-0083)

Previously cited in issue 17, p. 3011, Accession no. A81-38112

A83-30191#

AERODYNAMIC PERFORMANCE OF A WELLS AIR TURBINE

S. RAGHUNATHAN (Belfast, Queen's University, Belfast, Northern Ireland) and C. P. TAN Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 226-230 Research supported by the Department of Energy of England. refs

Experiments were performed in a unidirectional flow rig to assess the performance of the Wells self-rectifying air turbine. Results indicated that the efficiency of the turbine was very sensitive to the Reynolds number based on blade chord. Increase in Reynolds number by a factor of three resulted in an increase in peak efficiency from 37 to 60 percent. Increases in the solidity of the blade produced increases in pressure drop and power output but decreases in efficiency. The hub-to-tip ratio had only a weak influence on the turbine performance but is critical for starting conditions. It is concluded that a hub-to-tip ratio of 0.6 and a solidity of 0.6 are the most favorable values, taking into

consideration both the starting and running performances.

Author

A83-30192#

UTILITY OPERATING STRATEGY AND REQUIREMENTS FOR WIND POWER FORECAST

W. DUB and H. PAPE (Regensburg, Universitaet, Regensburg, West Germany) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 231-236. refs

Previously cited in issue 03, p. 397, Accession no. A82-14007

A83-30195#

DOUBLE MULTIPLE STREAMTUBE MODEL WITH RECENT IMPROVEMENTS

I. PARASCHIVOIU (Hydro-Quebec, Institut de Recherche, Varennes, Quebec, Canada) and F. DELCLAUX (UniversiteLaval, Quebec, Canada) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 250-255. refs

The objective of the present paper is to show the new capabilities of the double multiple streamtube (DMS) model for predicting the aerodynamic loads and performance of the Darrieus vertical-axis turbine. The original DMS model has been improved (DMSV model) by considering the variation in the upwind and downwind induced velocities as a function of the azimuthal angle for each streamtube. A comparison is made of the rotor performance for several blade geometries (parabola, catenary, troposkien, and Sandia shape). A new formulation is given for an approximate troposkien shape by considering the effect of the gravitational field. The effects of three NACA symmetrical profiles, 0012, 0015 and 0018, on the aerodynamic performance of the turbine are shown. Finally, a semiempirical dynamic-stall model has been incorporated and a better approximation obtained for modeling the local aerodynamic forces and performance for a Darrieus rotor.

Author

A83-30198#

ARC DAMAGE OF INTERELECTRODE INSULATORS IN MHD GENERATORS

W. UNKEL and L. D. BLACKMAN (MIT, Cambridge, MA) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 272-279. refs

(Contract DE-AC01-79ET-11518)

The damage characteristics of anode wall interelectrode insulators are presented. For designs typical of those used in present MHD channels, a stable interelectrode arc with a current of about 20 A at a magnetic field of 1 T can cut through an insulator at a speed in excess of from 1 to 2 mm/s and leave a damage track width of about 1-2 mm. The damage characteristics depend on both the arc power and the magnetic body force on the arc. The relationship of the 'safe' power of a design to the number of electrode elements required in a generator is presented. The question of damage from unsteady arcs is not resolved, although the unsteady heat transfer calculations indicates that the arcs must be separated by times larger than 100 ms for cooling of the insulator to occur between the individual arcs.

Author

A83-30199#

ELECTRICAL CHARACTERISTICS OF AN MHD GENERATOR WITH A TRANSVERSALLY SHAPED CONFIGURATION OF MAGNETIC INDUCTION

N. KAYUKAWA, Y. AOKI, Y. OZAWA (Hokkaido University, Sapporo, Japan), M. YOSHIDA (Kyoto University, Kyoto; Gifu University, Gifu, Japan), and J. UMOTO (Kyoto University, Kyoto, Japan) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 280-284. refs

Electrical characteristics of a Faraday-type MHD generator with a transversally shaped field configuration (SFC) of magnetic induction were investigated experimentally by using shock heated plasma. The magnetic induction was sharply reduced near electrodes in order to minimize the electrical losses caused by the Hall effect and the conductivity nonuniformity in the boundary layer. The performance of the proposed generator was experimentally compared with that of the conventional type with a

uniform field configuration. It was shown that the apparent conductivity, the output power, and the internal resistance were markedly improved in the SFC design, namely, by a factor of from about 1.5 to 2.0. The experimental characteristics agreed qualitatively with results of three-dimensional computer simulations. A possible arrangement of the superconducting coil for the generation of the SFC for a full-scale MHD generator channel was also proposed.

Author

A83-30200#

PERFORMANCE OF AN ANGULAR FLANGE AEROELASTIC WIND ENERGY CONVERTER

G. AHMADI (Clarkson College of Technology, Potsdam, NY) Journal of Energy (ISSN 0146-0412), vol. 7, May-June 1983, p. 285-288. Research supported by Clarkson College of Technology. refs

The effects of varying the flange width, flange angle, and pendulum weight on the performance of an angular flange H-section model of an aeroelastic wind energy converter are investigated. The results suggest that a larger flange width would improve the power coefficient considerably, while a larger flange angle and a pendulum weight increase would increase the power coefficient slightly. The efficiency of energy conversion is found to decrease with increased wind speed, and reasonable agreement is found with previous theoretical predictions on the normalized power coefficient. A method for possible improvement of the theoretical prediction is suggested and discussed.

C.D.

A83-30352

PHOTOVOLTAICALLY ACTIVE P LAYERS OF AMORPHOUS SILICON

B. W. FAUGHNAN and J. J. HANAK (RCA Laboratories, Princeton, NJ) Applied Physics Letters (ISSN 0003-6951), vol. 42, April 15, 1983, p. 722-724. Research supported by RCA (Contract XG-1-1169; XG-0-9372-1)

Studies on amorphous silicon p-n diodes have shown that the p layers are photovoltaically active. Jsc of up to 3.4 mA/sq cm and Voc of 780 mV have been observed. Detailed quantum efficiency measurements were performed as a function of bias voltage, p-layer thickness, and boron doping. The data fit a simple depletion width model in which all photogenerated carriers created inside the depletion region are collected. An additional 'reverse' barrier depletion width is assumed at the interface between the front transparent oxide electrode and the p layer to explain the results. A 10-nm-thick p layer typically used in p-i-n cells could collect up to 1 mA/sq cm if the electric field in the p layer is greater than 10 to the 5th V/cm.

Author

A83-30522#

THERMOELECTRIC GENERATION BY DIRECT HEAT EXCHANGE IN OCEAN THERMAL ENERGY CONVERSION

K. MATSUURA, T. HONDA, and H. KINOSHITA (Osaka University, Osaka, Japan) Osaka University, Technology Reports (ISSN 0030-6177), vol. 33, March 1983, p. 59-68.

A thermoelectric generator based on direct heat exchange is developed for an ocean thermal energy conversion system. This generator utilizes a fluorocarbon electric insulation fluid to exchange heat directly on an uncovered electrode. The properties of this type of generator are compared with those of a thermoelectric generator based on indirect heat exchange which uses acrylic resin plate insulators on the electrodes. Experimental and theoretical results are presented which demonstrate the excellent performance of the direct heat exchange generator in converting the thermal energy with a small temperature gradient between the warm and cold flow into electric energy. In addition, it is shown that the direct heat exchange generator has a much larger power output and also that the open terminal voltage, the effective internal resistance, and the power output of the generator are more influenced by the Reynolds number or the heat transfer coefficient at the transition layer between the liquid and the exposed thermoelectric generator electrode.

N.B.

A83-30549

THE DEVELOPMENT AND EVALUATION OF WIND FORECASTS FOR WIND ENERGY APPLICATIONS

H. L. WEGLEY (Battelle Pacific Northwest Laboratories, Richland, WA) IN: Conference on Weather Forecasting and Analysis, 9th, Seattle, WA, June 28-July 1, 1982, Preprints. Boston, MA, American Meteorological Society, 1982, p. 120-127. refs (Contract DE-AC06-76RL-01830)

Model output statistics (MOS) and a semi-objective approach were employed to define techniques for 24-hr wind forecasts for wind energy applications. Utilities with significant percentages of wind-electric generators need to plan optimum generator mixes on a daily basis. Data from 150 ft were reduced to hourly average values covering 23 mos and nine sites. Deterministic and probabilistic wind speed forecasts were formulated, the former for 7 different daily times and the latter for 0000 GMT and 1200 GMT. The MOS were used to estimate the probability of occurrence of each of seven wind speed categories, with the results linked to the power curve of a wind turbine. Attention was given to the bias, mean absolute error, and the rms error. The inclusion of on-site wind data brought the predictions to acceptable levels. Additional consideration is required to account for strong diurnal and seasonal variations. It is concluded that at least a 2 yr data base is required to initiate predictions, that probabilistic and deterministic forecasts have equal likelihood of correctness, and that predictions can be worthwhile to users of large scale wind derived electricity installations. M.S.K.

A83-30858

DESIGN FOR LONG FATIGUE LIFE IN RANDOM VIBRATION ENVIRONMENT

J. M. MEDAGLIA (General Electric Co., Philadelphia, PA) IN: Designing electronic equipment for random vibration environments; Proceedings of the Meeting, Los Angeles, CA, March 25, 26, 1982. Mount Prospect, IL, Institute of Environmental Sciences, 1982, p. 25-35. refs

It is pointed out that the design problem begins with quantification of the environment in which the equipment must function. Seemingly unrelated examples, such as electronic packages for spacecraft and windmills for electric power generation, show that the analytic method produces similar environmental descriptions. In every case spectra of amplitude versus frequency are created. The analysis of structural response to the environmental stimulus is the second of three main steps in design for long fatigue life. The third step is life prediction from comparison of the working stresses with allowable stresses. A list is presented of various steps which should be taken to enhance fatigue life in a random vibration environment. It is found that the root mean cube response is a useful single amplitude for design life. The Thomson-Baron formula for the response of a single degree of freedom oscillator in a random amplitude environment is also useful. G.R.

A83-30935

APPLICATION OF THE TURBO-REFRIGERATOR TO LONG-TERM CRYOGENIC STORAGE

P. G. WAPATO, R. H. NORMAN, and K. P. BARR (AiResearch Manufacturing Co., Torrance, CA) AIAA, SAE, ASME, AICHE, and ASMA, Intersociety Conference on Environmental Systems, 12th, San Diego, CA, July 19-21, 1982. 11 p. (SAE PAPER 820841)

It is pointed out that weight penalties caused by fluid vent loss can be high when lengthy periods of low usage are desired. The launch weight can be minimized through active refrigeration of the stored cryogen. The turbo-refrigerator is a closed-cycle cryogenic cooler eminently suited to such applications. Since this approach is based on the use of gas-bearing turbo-machinery, life limitations imposed by wear are virtually absent; this makes extremely long periods of uninterrupted operation feasible. The long-term storage of hydrogen and oxygen is investigated, and it is shown that for a one-year mission, refrigerated storage results in lower weight for usable liquid hydrogen quantities above 3500

lb. Regardless of the quantity, liquid oxygen storage penalties are less at this mission duration. C.R.

A83-31077

ON THE THEORY OF THE HORIZONTAL-AXIS WIND TURBINE

O. DE VRIES (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: Annual Review of Fluid Mechanics. Volume 15. Palo Alto, CA, Annual Reviews, Inc., 1983, p. 77-96. refs

The fluid mechanical theory of horizontal axis wind turbines (HAWT) in homogeneous, steady flows is presented. HAWT aerodynamic performance is governed by rotor torque and drag, the angular velocity, and power output, with governing equations for momentum, mass, and energy. The lift force and profile drag acting on the airfoil blades depend on the flow velocity, the chord length, the angle of attack, and the lift and drag coefficients. Single streamtube and multiple-stream tube and angular momentum analyses are employed to quantify the maximum wind turbine performance. Optimization studies for HAWT blades have indicated that a considerable amount of blade twist and taper enhances HAWT performance. Blade-element and vortex theory combined with panel methods are used to study optimum blade shapes. Techniques for assuring that wind tunnel studies of scale models are valid for full scale machines are defined. Sample runs have shown the accuracy of the blade element theory and the inaccuracies of two-dimensional analyses when stall is reached. The acquisition of more aerodynamic data on HAWT performance is indicated. M.S.K.

A83-31087* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A SUMMARY OF EHV PROPULSION TECHNOLOGY

H. J. SCHWARTZ (NASA, Lewis Research Center, Cleveland, OH) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb 1983, p. 3-6.

While the battery used by an electric vehicle is the primary determinant of range, and to a lesser extent of performance, the design of the vehicle's propulsion system establishes its performance level and is the greatest contributor to its purchase price. Propulsion system weight, efficiency and cost are related to the specific combination of components used. Attention is given to the development status of the U.S. Department of Energy's Electric and Hybrid Vehicle Program, through which propulsion component and system design improvements have been made which promise weight savings of 35-50 percent, efficiency gains of 25 percent, and lower costs, when compared to the state of the art at the program's inception. O.C.

A83-31089

SUMMARY OF ELECTRIC VEHICLE ENERGY SOURCE TECHNOLOGIES

I. B. WEINSTOCK and V. R. MATRICARDI (Aerospace Corp., Washington, DC) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 15-20. refs

The performance capabilities and potential problems associated with the advanced electrochemical energy sources under consideration for electrical vehicle propulsion are discussed, with attention to their development status, in light of projected performance requirements. While the laboratory evaluation of advanced battery systems indicates adequate performance levels, only two such systems, the zinc/chloride and sodium/sulfur systems, have been assembled into working units and operated in vehicles. These systems involve operational requirements that have not previously been encountered in battery applications, such as high operating temperatures and circulating electrolytes, which must be reconciled with vehicular design requirements. O.C.

A83-31092

FUEL CELL POWER PLANTS FOR AUTOMOTIVE APPLICATIONS

J. F. MCELROY (General Electric Co., Aircraft Equipment Div., Wilmington, MA) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol VT-32, Feb. 1983, p. 33-41.

While the Solid Polymer Electrolyte (SPE) fuel cell has until recently not been considered competitive with such commercial and industrial energy systems as gas turbine generators and internal combustion engines, electrical current density improvements have markedly improved the capital cost/kW output rating performance of SPE systems. Recent studies of SPE fuel cell applicability to vehicular propulsion have indicated that with adequate development, a powerplant may be produced which will satisfy the performance, size and weight objectives required for viable electric vehicles, and that the cost for such a system would be competitive with alternative advanced power systems. O.C.

A83-31093* Jet Propulsion Lab, California Inst. of Tech., Pasadena.

EHV SYSTEMS TECHNOLOGY - A LOOK AT THE PRINCIPLES AND CURRENT STATUS

D. W. KURTZ and R. R. LEVIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 42-50. Research supported by the U.S. Department of Energy and NASA. refs

An examination of the basic principles and practices of systems engineering is undertaken in the context of their application to the component and subsystem technologies involved in electric and hybrid vehicle (EHV) development. The limitations of purely electric vehicles are contrasted with hybrid, heat engine-incorporating vehicle technology, which is inherently more versatile. A hybrid vehicle concept assessment methodology is presented which employs current technology and yet fully satisfies U.S. Department of Energy petroleum displacement goals. O.C.

A83-31094* Jet Propulsion Lab, California Inst of Tech., Pasadena.

ADVANCED VEHICLE SYSTEM CONCEPTS

K. S. HARDY and J. M. LANGENDOEN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 51-61. Research supported by the U.S. Department of Energy and NASA refs

Various nonpetroleum vehicle system concepts for passenger vehicles in the 1990's are being considered as part of the Advanced Vehicle (AV) Assessment at the Jet Propulsion Laboratory. The vehicle system and subsystem performance requirements, the projected characteristics of mature subsystem candidates, and promising systems are presented. The system candidates include electric and hybrid vehicles powered by electricity with or without a nonpetroleum power source. The subsystem candidates include batteries (aqueous-mobile, flow, high-temperature, and metal-air), fuel cells (phosphoric acid, advanced acids, and solid polymer electrolyte), nonpetroleum heat engines, advanced dc and ac propulsion components, power-peaking devices, and transmissions. Author

A83-31095

THE ROLE OF COMPUTER MODELING AND SIMULATION IN ELECTRIC AND HYBRID VEHICLE RESEARCH AND DEVELOPMENT

R. P. WOLFSON and J. H. GOWER (Aerospace Corp, Washington, DC) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol VT-32, Feb. 1983, p. 62-73. Research supported by the U.S. Department of Energy refs (Contract F04701-83-C-0083)

Computer modeling-assisted studies and assessments of electric and hybrid vehicle candidate technologies have been undertaken to provide data for management planning and research effort decisions, as well as for engineering activities such as preliminary and final design optimization. A discussion is presented

concerning the range of programs which have been developed for these purposes, extending from small programs that can be run on hand-held calculators to lengthy programs running to more than 11,000 lines. It is noted that many of these programs exist in the public domain, and that two major programs are available on commercial time-sharing systems. O.C.

A83-31801

A REVIEW OF COMMUTER PROPULSION TECHNOLOGY

A. BROOKS and R. HIRSCHKRON (General Electric Co., Lynn, MA) Society of Automotive Engineers, Commuter Aircraft and Airline Operations Meeting, Savannah, GA, May 24-26, 1982. 9 p. (SAE PAPER 820716)

Engines for modern commuter turboprop aircraft are discussed. The status of the market is briefly addressed, and the CT7 engine is described, showing parameters for its two versions. The results of a study conducted in order to identify advanced engines and technologies for future commuter turboprops are discussed, showing the evaluation procedure and the merit factors. The cycle selection from a series of twelve engines covering a range of cycle pressure ratios from 11.5 to 30, and a range of turbine inlet temperatures from 1830 to 2500 F is described. The trends in turbine cooling flow SFC, weight, price, and maintenance used in the study are presented. Cycle and staging parameters are shown for the two selected engines, and the potential benefits of advanced power plants and other technologies for future commuter aircraft are assessed. C.D.

A83-32427

AC CHARACTERISTICS IN AC/DC/DC CONVERSION

P. MARINO (Napoli, Universita, Naples, Italy), C. PICARDI (Calabria, Universita, Cosenza, Italy), and A. RUSSO (Ente Nazionale per l'Energia Elettrica, Naples, Italy) IEE Proceedings, Part B - Electric Power Applications (ISSN 0143-7038), vol 130, pt. B, no 3, May 1983, p. 201-206. refs

The ac characteristics of a double-conversion system are investigated. Using a simple method, the harmonic composition of the alternating currents are determined as a function of the connection type of the ac/dc rectifier and of the parameters characterizing the dc/dc chopper operations. It is shown that the best ac characteristics are only achieved when the chopper modulation frequency is a multiple of the product of the ac/dc converter pulse number and the inverse of the supply period. Under these conditions, subharmonics and unbalance components are not generated in the ac currents. C.D.

A83-32713#

FEASIBILITY OF LASER-DRIVEN REPETITIVELY-PULSED MHD GENERATORS

C. D. MAXWELL (STD Research Corp, McLean, VA) and L. N. MYRABO (BDM Corp, McLean, VA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 14 p. USAF-DARPA-sponsored research. refs

(AIAA PAPER 83-1442)

A feasibility analysis is presented for laser-driven, repetitively-pulsed (RP) magnetohydrodynamic generators proposed for shared propulsion and electric-power roles in near earth missions. Two basic approaches are analyzed in detail: (1) open-cycle H2 devices suitable for direct laser thermal RP rockets, and (2) closed-cycle monatomic gas devices compatible with RP electromagnetic accelerators. As thrusters, the former variety can produce specific impulses in the range of 1000-2000 seconds, whereas, the latter could enable 3000-10,000 seconds and beyond. Although no such electric power generating devices currently exist, the analysis draws heavily upon an extensive body of knowledge on analogous chemical explosive-driven magnetohydrodynamic (XMHD) generators. Author

A83-33976

CONTINUOUS-WAVE**INDUSTRIAL****ELECTRON-BEAM-CONTROLLED CO LASER OF 10 KW OUTPUT POWER**

A. P. AVERIN, N. G. BASOV, L. A. VASILEV, E. P. GLOTOV, M. I. GOLOVIN, V. A. DANILYCHEV, O. M. KERIMOV, M. M. MALYSH, B. M. SEMEROV, A. M. SOROKA (Akademiia Nauk SSSR, Fizicheskii Institut, Moscow, USSR) et al. (Kvantovaya Elektronika /Moscow/, vol. 9, Dec. 1982, p. 2357-2358) Soviet Journal of Quantum Electronics (ISSN 0049-1748), vol. 12, Dec. 1982, p. 1537, 1538. Translation refs

The construction of a CW electron-beam-controlled CO laser with an output power of 10 kW is presented. It is shown that the lasing efficiency increased as the specific input energy increased. At each pressure there was an optimal rate of circulation of a laser mixture at which the maximum laser radiation power was obtained, since the cryogenic heat exchanger was unable to cool the gas sufficiently when the circulation rate was high. The maximum lasing efficiency was found to reach 24 percent and the specific output energy from a unit mass of the circulated gas was 65 J/g, which is significantly greater than the values reported for existing industrial CO₂ lasers. N.B.

A83-33988#

BUBBLE NUCLEATION AND GROWTH IN OPEN-CYCLE OTEC SUBSYSTEMS

D. C. BUGBY, A. T. WASSEL (Science Applications, Inc., El Segundo, CA), and A. F. MILLS (Science Applications, Inc., El Segundo, California, University, Los Angeles, CA) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 119-125. Research supported by the Solar Energy Research Institute. refs

Bubble nucleation and growth in the evaporator, condenser, upcomers, and feedwater distribution systems of open-cycle ocean thermal energy conversion (OTEC) power plants are examined. The phenomenon that will probably have the most impact on system design is cavitation in the warm water feed near the entrance of the evaporator. The critical bubble size for cavitation is about 105 microns. Sources of bubbles in the warm water feed are those entering from the ocean, those nucleating on suspended particles, and those nucleating on the upcomer wall. Analyses of bubble growth induced by changes in hydrostatic pressure, mass transfer, and coalescence are presented. Using available information for bubble size distribution in seawater at California locations, it is shown that cavitation will probably have a significant impact on evaporator performance unless a debubbler is provided upstream of the evaporator entrance. Author

A83-33992#

VAPOR/DROPLET COUPLING AND THE MIST FLOW (OTEC) CYCLE

C. K. B. LEE and S. L. RIDGWAY (R & D Associates, Marina del Rey, CA) ASME, Transactions, Journal of Solar Energy Engineering (ISSN 0199-6231), vol. 105, May 1983, p. 181-186. Research supported by the U.S. Department of Energy. refs

A83-34148

THE OPERATING EXPERIENCES AND PERFORMANCE CHARACTERISTICS DURING THE FIRST YEAR OF OPERATION OF THE CROTCHED MT. NEW HAMPSHIRE WINDFARM

D. P. SYMANSKI (New England Power Service Co., Westborough, MA) (Institute of Electrical and Electronics Engineers, Summer Meeting, San Francisco, CA, July 18-23, 1982) IEEE Transactions on Power Apparatus and Systems (ISSN 0018-9510), vol. PAS-102, June 1983, p. 1637-1641.

Equipment and performance features of the utility interconnections with the 20 unit pioneer windfarm of 30 kW induction generator wind turbines on Crotched Mt., NH are detailed. The windfarm is connected to a 12.47 kV distribution line and a substation consisting of a 14.4 kV, 560 A vacuum circuit closer, a bank of three 200 kVAR capacitors, a single phase 10 kVA service transformer, and metering transformers. Voltage support is supplied by the capacitor bank during high reactive power flow periods

into the windfarm. Over and underspeed protection is provided by a tachometer on the wind turbine shaft, and deviation from 1800 rpm by any significant amount results in tripping of a 480 V contactor. An 8 kW load is continuous to maintain microprocessor heating as well as brake operation and control functions. The safety devices provided adequate protection during power outages, and the power quality was found to be satisfactory. Suggestions are offered for improving light-load registration to account for kVars and low output M.S.K.

A83-34149

METHODS OF REDUCING WIND POWER CHANGES FROM LARGE WIND TURBINE ARRAYS

R. A. SCHLUETER, G. L. PARK, M. LOTFALIAN, H. SHAYANFAR (Michigan State University, East Lansing, MI), and J. DORSEY (Georgia Institute of Technology, Atlanta, GA) (Institute of Electrical and Electronics Engineers, Summer Meeting, San Francisco, CA, July 18-23, 1982) IEEE Transactions on Power Apparatus and Systems (ISSN 0018-9510), vol. PAS-102, June 1983, p. 1642-1650.

(Contract EC-77-S-02-4450, DE-AC02-79ET-23168)

Methods for reducing the changes incurred by wind energy conversion systems (WECS) arrays experiencing atmospheric events that fluctuate near the load-following limit of the grid regulation are presented. Both analytical and computer simulation results are given for increasing the WECS generation output over a short period to compensate for the transient; attention is focussed on a 10 min passage of a thunderstorm over an echelon and a windfarm. Choice of an appropriate wind turbine configuration is shown to permit control of the variation of output while simultaneously reducing the effective level of windfarm grid penetration. A storm gust can increase the output from zero to rated power in less than a minute. Coordinated controllable pitch blades and careful selection of sites and array configuration can smooth the abrupt changes otherwise experienced by the grid. Consideration is given to echelons and arrays of Mod 2s and Mod 1s arranged so that the distance between echelons are commensurate with distances between storm leading edges and trailing inflows M.S.K.

A83-34403

THE EVALUATION OF THE POWER COEFFICIENT OF A SAVONIUS ROTOR [EVALUATION DU COEFFICIENT DE PUISSANCE D'UN ROTOR SAVONIUS]

A. CHAUVIN, M. BOTRINI, R. BRUN, and C. BEGUIER (Aix-Marseille II, Université, Marseille, France) Académie des Sciences (Paris), Comptes Rendus, Série II Mécanique, Physique, Chimie, Sciences de l'Univers, Sciences de la Terre (ISSN 0249-6305), vol. 296, no. 11, March 21, 1983, p. 823-826. In French. refs

Measurements of the pressure variations and the blade drag on a Savonius rotor with partially overlapping blades set at different angles of attack are employed to develop a model for the power coefficient. The data were taken in a wind tunnel with probes placed on the interior and exterior surfaces of a blade from the leading edge to the trailing edge in a series of seven trials with each angle of attack. Two rotary regimes were noted, the first, motoring, which lasted up to an angle of attack of 145 deg, and a resistant mode, which lasted up to 180 deg. A two-dimensional model is developed for a horizontal slice of the Savonius, taking into account the aerodynamic forces on the retreating and advancing blades. It is found that the drag increase with the rotation speed, eventually providing an upper limit to the power available. A maximum power coefficient of 0.17 is projected. M.S.K.

A83-34860

NEW CONCEPT IN HOVERCRAFT DESIGN DIESEL VERSUS GAS TURBINES

D. E. EMMAS IN: Canadian Symposium on Air Cushion Technology, 16th, Charlottetown, Prince Edward Island, Canada, October 19-21, 1982, Preprints. Ottawa, Canadian Aeronautics and Space Institute, 1982, p. 64-68.

The fuel cost increases experienced during the 1970s compelled certain hovercraft designers to investigate the relative advantages of the use of lightweight diesel engines rather than the previously favored gas turbines, which had higher fuel consumption. The AP1-88 hovercraft presently considered has been tested with both air-cooled and water-cooled diesel engines. Although fuel consumption reduction was the paramount consideration in the test program undertaken, engine weight reduction was also sought, and resulted in the choice of turbocharged versions of both the air- and water-cooled engines O.C.

A83-36350#

LASER-DRIVEN MHD-FANJET

L. N. MYRABO (BDM Corp., McLean, VA), M. MARTINEZ-SANCHEZ (MIT, Cambridge, MA), and D. HEIMERDINGER AIAA, SAE, and ASME, Joint Propulsion Conference, 19th, Seattle, WA, June 27-29, 1983 24 p. Research supported by Brookhaven National Laboratory. refs (AIAA PAPER 83-1345)

An analysis is performed on the concept of an electromagnetic fanjet powered by laser energy beamed from remote ground-based or space-based power plants. The engine is designed for efficient air-breathing propulsion in the flight regime from Mach 1 to 15 and altitudes from 15 to 70 Km. A one-dimensional analytical model is derived for the transient behavior of high electric current plasma sheets used to accelerate air in the MHD-fanjet. This model, which examines the detailed structure of the current sheet itself, gives insight into factors controlling sheet dynamics. Additional calculations are performed with a radially-symmetric two-dimensional 'snow-plow' model, for a nominal 10m diameter MHD-fanjet flying along an exemplary trajectory to space. Finally, some aspects of the MHD-Fanjet electrode requirements and design features are reviewed Author

A83-36410* Westinghouse Electric Corp., Pittsburgh, Pa
MEASURED EFFECT OF WIND GENERATION ON THE FUEL CONSUMPTION OF AN ISOLATED DIESEL POWER SYSTEM

P. H. STILLER, G. W. SCOTT (Westinghouse Electric Corp., Pittsburgh, PA), and R. K. SHALTENS (NASA, Lewis Research Center, Cleveland, OH) (Institute of Electrical and Electronics Engineers, Winter Meeting, New York, NY, Jan 30-Feb 4, 1983) IEEE Transactions on Power Apparatus and Systems (ISSN 0018-9510), vol. PAS-102, June 1983, p. 1788-1792. Research supported by the U.S. Department of Energy (Contract DEN3-275)

The Block Island Power Company (BIPCO), on Block Island, Rhode Island, operates an isolated electric power system consisting of diesel generation and an experimental wind turbine. The 150-kW wind turbine, designated MOD-OA by the U.S. Department of Energy is typically operated in parallel with two diesel generators to serve an average winter load of 350 kW. Wind generation serves up to 60 percent of the system demand depending on wind speed and total system load. Results of diesel fuel consumption measurements are given for the diesel units operated in parallel with the wind turbine and again without the wind turbine. The fuel consumption data are used to calculate the amount of fuel displaced by wind energy. Results indicate that the wind turbine displaced 25,700 lbs of the diesel fuel during the test period, representing a calculated reduction in fuel consumption of 6.7 percent while generating 11 percent of the total electric energy. The amount of displaced fuel depends on operating conditions and system load. It is also shown that diesel engine throttle activity resulting from wind gusts which rapidly change the wind turbine output do not significantly influence fuel consumption. Author

A83-36451

LIQUID-METAL FLOWS AND MAGNETOHYDRODYNAMICS; BEERSHEBA INTERNATIONAL SEMINAR ON MAGNETOHYDRODYNAMIC FLOWS AND TURBULENCE, 3RD, UNIVERSITY OF THE NEGEV, BEERSHEBA, ISRAEL, MARCH 23-27, 1981, TECHNICAL PAPERS

H. BRANOVER, ED. (Negev, University, Beersheba, Israel), P. S. LYKODIS, ED. (Purdue University, West Lafayette, IN), and A. YAKHOT (Negev, University, Beersheba, Israel) New York, American Institute of Aeronautics and Astronautics (Progress in Astronautics and Aeronautics. Volume 84), 1983, 475 p.

The papers contained in this volume provide an overview of the present status of studies in liquid-metal MHD flows, including some related problems of MHD of a general kind and different applications of these flows. The topics discussed include fundamental studies in MHD and turbulence; MHD generation and electromagnetic flowmeters; electromagnetic pumps, flow couplers, fission and fusion applications; and metallurgical magnetohydrodynamics. Papers are presented on a finite-element analysis of two-dimensional MHD flows, electromagnetic stirring in the coreless induction furnace, liquid-solid separation in a molten metal by a stationary electromagnetic field, and magnetic levitation of liquid metals. No individual items are abstracted in this volume V.L.

A83-37221#

EFFECTS OF SHORT-DURATION LOADING FAULTS ON HIGH-INTERACTION FARADAY AND DIAGONAL TYPE MHD GENERATORS WITH SUBSONIC OR SUPERSONIC FLOW

M. ISHIKAWA and J. UMOTO (Kyoto University, Kyoto, Japan) American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 16th, Danvers, MA, July 12-14, 1983. 11 p. refs (AIAA PAPER 83-1745)

Unsteady behaviors caused by external loading faults are studied numerically in four high-interaction MHD generators (subsonic Faraday, supersonic Faraday, subsonic diagonal, and supersonic diagonal configurations) in order to determine the effects of recovery from loading faults in large-scale MHD generators. Unsteady one-dimensional equations are solved using the method of McCormack (1969), coupled with the Maxwell equations and the generalized Ohm's law. Results show that a short fault of the external loading circuit is more harmful than an open fault for the Faraday type configurations, while the open fault is more dangerous in the large-scale diagonal channel. A shock wave propagating upstream is induced in the case of a short fault of subsonic Faraday and an open fault of subsonic diagonal types, while no disturbance proceeds upstream in the supersonic flows. Larger electrical stress is found in the Faraday than in the diagonal configurations. In addition, the recovery of faults is shown to have clear effects on the flow properties as well as on the electrical stresses, except for the case of the subsonic diagonal type channel. N.B.

A83-37505#

THE ECONOMICAL UTILIZATION OF GEOTHERMAL ENERGY [ZUR WIRTSCHAFTLICHEN NUTZUNG DER GEOTHERMISCHEN ENERGIE]

G. ROSE Braunschweig, Technische Universität, Fakultät fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1982, 141 p. In German. refs

The geothermal energy which is stored in hot dry rock could be theoretically utilized for the generation of power. The hot-dry-rock procedure can provide a flow of hot water. The considered binary system can transform the obtained thermal energy into electrical energy. The system makes use of a Rankine cycle with a working fluid having a low boiling point. Heat from the hot water is transferred to the working fluid. The present investigation is concerned with the development of a method for the calculation of the entire process. The results obtained with the computational method are to provide a basis for the determination of the operational characteristics. The development method is used for the study of a process based on the use of

carbon dioxide as working fluid. The economics of a use of the hot-dry-rock process with the binary system is also investigated. It is found that the considered procedure is not economical. Economical operation requires, in particular, hot water supplied at a much lower cost. G.R.

A83-38012#**THREE-DIMENSIONAL FLOW DEVELOPMENT IN MHD GENERATORS AT PART LOAD**

E. D. DOSS and R. K. AHLUWALIA (Argonne National Laboratory, Argonne, IL) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug 1983, p. 289, 290. Research supported by the U.S. Department of Energy.

Previously cited in issue 07, p. 1121, Accession no. A82-19794

A83-38014#**OCEAN THERMAL ENERGY CONVERSION - HISTORICAL HIGHLIGHTS, STATUS, AND FORECAST**

G. L. DUGGER, D. RICHARDS, E. J. FRANCIS, and W. H. AVERY (Johns Hopkins University, Laurel, MD) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug. 1983, p. 293-303. Research supported by the U.S. Department of Energy and U.S. Department of Commerce. refs

Design concepts, materials, and performance data from the first OTEC demonstration plants are reviewed. The first plant, using a closed cycle fluid loop (NH₃), generated 10-15 kWe in 1979 at Keahole Point, HI. Subsequently, a follow-up project provided data on 1 MWe heat exchangers and biofouling in 1981. The federal government passed legislation in 1980 mandating the generation of 500 MW from OTEC plants in 1989 and 10 GW in 1999. A resource assessment has indicated favorable temperature gradients in retrievable depths of near 24 deg C in the Atlantic and the Pacific. Sensitivity analyses have shown that the cost of electricity from OTEC plants varies with the length of cable needed to deliver the power, the resource, standardization of OTEC components, and the choice of moored or cruising ships (which could follow seasonal temperature changes). Overall efficiencies for the OTEC plants of about 2.5 pct are projected. Baseline designs have been developed for 40 MWe plants, although choices are not yet finalized for the cold water intake or final product, whether electricity, NH₃, or methanol for fuel cells. M S K.

A83-38016#**OPTIMIZATION OF DARRIEUS TURBINES WITH AN UPWIND AND DOWNWIND MOMENTUM MODEL**

J. L. LOTH and H. MCCOY (West Virginia University, Morgantown, WV) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug 1983, p. 313-318. refs

(Contract DE-FG02-80CS-89001)

Previously cited in issue 03, p. 400, Accession no. A82-14031

A83-38017#**MODULAR SIMULATION MODEL FOR A WIND TURBINE SYSTEM**

S. BERGMAN (Sydkraft AB, Malmo, Sweden), S. E. MATTSSON, and A. B. OSTBERG (Lund Institute of Technology, Lund, Sweden) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug. 1983, p. 319-324. Research supported by the Swedish Board for Energy Source Development. refs

Previously cited in issue 03, p. 398, Accession no. A82-14017

A83-38020#**MAGNETOHYDRODYNAMIC GENERATOR SCALING ANALYSIS FOR BASELOAD COMMERCIAL POWERPLANTS**

D. W. SWALLOM and C. C. P. PIAN (Avco Everett Research Laboratory, Everett, MA) Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug. 1983, p. 338-344. refs

(Contract DE-AC01-80ET-15614)

Previously cited in issue 06, p. 899, Accession no. A82-17922

A83-38024#**SIMULATION OF STARTING TRANSIENTS IN THE UTSI MHD GENERATOR**

Y. F. LIAO, H. J. SCHMIDT, Y. C. L. WU (Tennessee, University, Tullahoma, TN), and M. ISHIKAWA Journal of Energy (ISSN 0146-0412), vol. 7, July-Aug. 1983, p. 374-381. refs

(Contract DE-AC02-79ET-10815)

Previously cited in issue 15, p. 2434, Accession no. A82-31910

N83-23371*# National Aeronautics and Space Administration, Washington, D. C.

MODELING AND TECHNICAL USE OF GAS EVOLVING ELECTRODES. PART 2: MODELING OF GAS-EVOLVING ELECTROLYZERS WITH FREE ELECTROLYTE CIRCULATION

M. SCHLEIFF, W. THIELE (Buna Chemical Plant), and H. MATSCHINER Mar 1983 12 p refs Transl. into ENGLISH Chem. Tech. (Leipzig), v. 34, no. 5, 1982 p. 250-252

(Contract NASW-3541)

(NASA-TM-77045; NAS 1.15:77045) Avail NTIS HC A02/MF A01 CSCL 07D

In an electrochemical reactor with gas-evolving electrodes, the transporting action of the gas bubbles can be used to move the electrolyte in a cycle flow, when the structure of the flow channels is suitable. For an electrolysis cell with such a circulation system a mathematic model was set up and evaluated. It is shown that in this manner, a rapid flow through the electrode gap can be achieved without additional energy consumption, in addition to a low gas fraction and a low cell voltage. The cell voltage and the attainable cycle spread are investigated as a function of the geometric parameters for their optimum values. Author

N83-23541# Stanford Univ., Calif. High Temperature Gasdynamics Lab.

CURRENT DISTRIBUTION AND NONUNIFORMITY EFFECTS IN MHD DISK GENERATORS Ph.D. Thesis

D. F. ROSEMAN Aug 1982 156 p refs

(Contract DE-AC01-80ET-15611)

(DE83-000522, HTGL-231) Avail NTIS HC A08/MF A01

Current distribution and nonuniformity effects in combustion driven MHD disk generators were studied. The importance of these phenomena to baseload power generation was investigated. The peg wall construction allowed current and voltage distributions to be measured. The channel was operated with plasma temperatures up to 2750 K and magnetic field strengths up to 5.5 Tesla. The magnitudes of the currents and voltages were reduced by significant loss mechanisms, primarily electrode losses and current leakage through the wall caused by potassium seed penetration of the castable ceramic between the pegs. A simple circuit model accounting for these losses was developed to be compared with analytical calculations. Under normal uniform electrical loading the distributions measured in the channel were uniform as expected. Nonuniform electrical loading was used to produce and measure effects on the current distribution that occur only in the presence of high magnetic fields as required for MHD power generation. DOE

N83-23698*# Westinghouse Research and Development Center, Pittsburgh, Pa.

EVALUATION OF SOLID OXIDE FUEL CELL SYSTEMS FOR ELECTRICITY GENERATION Final Report

E. V. SOMERS, E. J. VIDT, and R. E. GRIMBLE Dec. 1982 35 p refs

(Contract NAS7-100; JPL-956252; DE-AC20-80ET-17089)

Avail NTIS HC A03/MF A01 CSCL 10A

Air blown (low BTU) gasification with atmospheric pressure Solid Electrolyte Fuel Cells (SOFC) and Rankine bottoming cycle, oxygen blown (medium BTU) gasification with atmospheric pressure SOFC and Rankine bottoming cycle, air blown gasification with pressurized SOFC and combined Brayton/Rankine bottoming cycle, oxygen blown gasification with pressurized SOFC and combined Brayton/Rankine bottoming cycle were evaluated. Author

05 ENERGY CONVERSION

N83-23722# Midwest Research Inst , Golden, Colo Solar Energy Research Inst.

PROCEEDINGS: SMALL WIND TURBINE SYSTEMS, 1981

1981 438 p refs Conf. held in Boulder, Colo., 12-14 May 1981, sponsored by Rockwell International Corp. and Dept. of Agriculture

(Contract DE-AC04-76DP-3533)

(SERI/CP-635-1212) Avail NTIS HC A19/MF A01

Small wind turbine technology is discussed Systems development, test programs, utility interface issues, safety and reliability programs, applications, and marketing are discussed

R.J.F.

N83-23723# Aerospace Systems, Inc., Burlington, Mass.

HIGH-RELIABILITY VERTICAL-AXIS WIND TURBINE

R B. NOLL and J. ZVARA /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 17-28 1981 refs

Avail: NTIS HC A19/MF A01

A review of the design and development of a 1-kW high-reliability vertical-axis small wind energy conversion system (SWECS) is presented The SWECS is a straight-bladed version of the Darneus design It incorporates high-reliability components in order to obtain a design value of mean time between failures of ten years based on one maintenance day a year Design features are described, automatic control of the turbine is discussed, and typical results from controlled velocity testing are presented

R.J.F.

N83-23724# United Technologies Research Center, East Hartford, Conn.

UTRC 15 KW WIND TURBINE DEVELOPMENT

M. C. CHENEY /in Midwest Research Inst Proc.: Small Wind Turbine Systems, 1981 p 31-46 1981 refs

Avail: NTIS HC A19/MF A01

The prototype design and performance of a 15 kW wind turbine is described A bearingless rotor concept was followed. The 15 kW design is a growth version of a smaller system and incorporates many improvements identified during the 8 kW program Two significant changes made were to replace the guyed tower design with a free standing tower and to incorporate the main frame and rotor shaft supports into the transmission Fabrication was completed early in 1981 and initial testing began in March 1981 Successful operation of the prototype was achieved during field tests

R J F

N83-23725# Rockwell International Corp , Golden, Colo. Energy Systems Group.

STATUS OF SWECS TESTING PROGRAMS AT THE ROCKY FLATS SMALL WIND SYSTEMS TEST CENTER

I. B. ALLEN /in Midwest Research Inst Proc. Small Wind Turbine Systems, 1981 p 51-63 1981

Avail NTIS HC A19/MF A01

Testing programs for wind turbines at the new Rocky Flats Wind Systems test center are discussed Prototype testing and data acquisition capabilities are discussed.

R.J.F

N83-23726# United Technologies Research Center, East Hartford, Conn

UTRC 8 KW WIND TURBINE DEVELOPMENT

T. A. MURRIN /in Midwest Research Inst Proc Small Wind Turbine Systems, 1981 p 67-76 1981 refs

Avail NTIS HC A19/MF A01

A prototype 8 kW Wind Turbine Generator was redesigned for reduced cost and increased reliability and designated the UTRC Model 108 A test program was conducted using a Model 108 equipped with power and load-measuring instrumentation, and measurements were made of system performance, blade pitch angle, and rotor moments The Model 108 design is discussed and changes from the prototype 8 kW system are highlighted. The results of the test program are given along with an analyses conducted during the development effort.

R.J.F

N83-23727# Kaman Aerospace Corp , Bloomfield, Conn

DEVELOPMENT AND TESTING OF THE KAMAN 40 KW TURBINE GENERATOR

B. A. GOODALE /in Midwest Research Inst. Proc Small Wind Turbine Systems, 1981 p 81-92 1981

Avail NTIS HC A19/MF A01

A horizontal axis wind turbine generator rated at 40 kW at 9 m/s is discussed The system has a 19.5 m diameter rotor with two fiberglass blades mounted downwind of the tower at a hub height of 23 m. To accommodate various output configurations, a variable pitch rotor with a microprocessor controller is incorporated. During fabrication, lessons were learned which will improve producibility at lower costs, and these are discussed. Also discussed are some of the development problems encountered and corrected during the Contractor's test program and during the testing now in process at the Rocky Flats facility Performance appears to show good correlation with predicted levels, and the prototype is considered to represent a successful system on which to base future production.

R J F.

N83-23728# McDonnell Aircraft Co , St Louis, Mo

THE 40 KW GIROMILL

J. ANDERSON /in Midwest Research Inst. Proc: Small Wind Turbine Systems, 1981 p 93-105 1981

Avail NTIS HC A19/MF A01

A prototype Giromill wind turbine is discussed. The Giromill is a vertical axis wind turbine with articulating vertical blades programmed through a microprocessor to catch the wind from any direction and maintain constant rotor RPM The articulating blades provide not only a very high energy conversion efficiency but also a self-starting capability and additional safety by allowing the blades to weathervane in high winds. The blades are straight and simple structures with no twist and, much like the remaining structure, is less complex than many other windmills. Power transmission, control system, and electrical generator are located at the ground level for convenient access and maintenance. Direct mechanical power is also available at ground level for irrigation pumping.

R.J.F

N83-23729# Central Solar Energy Research Corp , Detroit, Mich

ANALYZING THE REQUIREMENTS FOR MASS PRODUCTION OF SMALL WIND TURBINE GENERATORS

T. ANUSKIEWICZ, J. ASMUSSEN, and O. FRANKENFIELD /in Midwest Research Inst Proc. Small Wind Turbine Systems, 1981 p 107-121 1981

Avail NTIS HC A19/MF A01

Mass producibility of small wind turbine generators to give manufacturers design and cost data for profitable production operations is discussed. A 15 kW wind turbine generator for production in annual volumes from 1,000 to 50,000 units is discussed Methodology to cost the systems effectively is explained. The process estimate sequence followed is outlined with emphasis on the process estimate sheets compiled for each component and subsystem These data enabled analysts to develop cost breakdown profiles crucial in manufacturing decision-making. The appraisal also led to various design recommendations including replacement of aluminum towers with cost effective carbon steel towers Extensive cost information is supplied in tables covering subassemblies, capital requirements, and leveled energy costs. The physical layout of the plant is depicted to guide manufacturers in taking advantage of the growing business opportunity now offered in conjunction with the national need for energy development.

R J F.

N83-23730# Rockwell International Corp., Golden, Colo. Energy Systems Group.

SWECS TOWER DYNAMICS ANALYSIS METHODS AND RESULTS

A. D. WRIGHT /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 127-147 1981 refs

Avail: NTIS HC A19/MF A01

At the Rocky Flats Wind Systems Center, several different tower dynamics analysis methods and computer codes are used to determine the natural frequencies and mode shapes of both guyed and freestanding wind turbine towers. These analysis methods are described and the results for two types of towers: a guyed tower and a freestanding tower are shown. The advantages and disadvantages in the use of and the accuracy of each method are also described. R.J.F.

N83-23731# Rockwell International Corp., Golden, Colo. Wind Systems Program.

COMPARISON OF WIND TURBINE PERFORMANCE PREDICTION AND MEASUREMENT

J. L. TAngLER /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 149-161 1981 refs

Avail: NTIS HC A19/MF A01

The state-of-the-art of performance prediction for small horizontal-axis wind turbines is discussed. Several existing performance models from four contractors were evaluated by comparing their predictions for two wind turbines with actual test data. Test data were acquired by Rocky Flats Test and Development Center and furnished to the contractors after submission of their prediction reports. The results of the correlation study help identify areas in which existing rotor performance models are inadequate and, where possible, the reasons for the models shortcomings. In addition, several problems associated with obtaining accurate test data are discussed. R.J.F.

N83-23732# Aerospace Systems, Inc., Burlington, Mass.

EFFECTS OF DYNAMIC STALL ON SWECS

R. B. NOLL and N. D. HAM (MIT) /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 171-183 1981 refs

Avail: NTIS HC A19/MF A01

A study of dynamic stall is presented in order to define its influence on the airfoil force and moment coefficients so that these effects can be included in the calculation of small wind energy conversion system (SWECS) loads and responses. A review of past work indicates that semiempirical methods are best suited to SWECS requirements. A definition of a dynamic stall theory is made for use in SWECS design, and the theory is implemented in SWECS loads and dynamic response analyses. Sample calculations are made for a representative vertical-axis machine. It is shown that loads and moments on the blades may be underestimated if dynamic stall is not considered. Author

N83-23733# Rockwell International Corp., Golden, Colo. Energy Systems Group.

EARLY RESULTS FROM THE SWECS ROTOR WAKE MEASUREMENT PROJECT

A. C. HANSEN /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 185-199 1981 refs

Avail: NTIS HC A19/MF A01

Tests were conducted to quantitatively measure the nature and extent of the far wake of a horizontal-axis wind turbine. The tests were conducted at the Department of Transportation, Transportation Test Center in Pueblo, Colorado using controlled velocity tests. Early results presented in this paper show the width and downwind extent of the mean velocity wake. The measured interdependence of the wake strength and SWECS power coefficient is also presented. It is shown that the mean velocity wake is detectable on the wake centerline 14 at rotor diameters from the rotor hub. Author

N83-23734# National Conference of State Legislatures, Denver, Colo.

INTERCONNECTION STANDARDS FOR SMALL POWER PRODUCERS. A SURVEY

D. M. SACARTO /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 203-218 1981

Avail: NTIS HC A19/MF A01

This paper summarizes results from a survey of state utility commissions and selected utility companies regarding their standards for interconnecting small power producers with electric utility systems under the requirements of the Public Utility Regulatory Policies Act. Twenty-six utility companies and the commissions in the fifty states, District of Columbia, Guam, Virgin Islands and Puerto Rico were surveyed. The survey was conducted under a subcontract from the Rocky Flats Wind Systems Program of the Rockwell International Corporation as part of its assessment of institutional barriers to small wind energy systems. Rockwell International is the prime contractor to the United States Department of Energy in the development and commercialization of small wind energy systems. Interconnection standards are concerned with safety standards and liability, metering, payment of costs, and power quality (e.g., voltage regulation, harmonics, synchronization). B.W.

N83-23738# Rockwell International Corp., Golden, Colo. Energy Systems Group.

WIND MACHINE FATIGUE ANALYSIS AND LIFE PREDICTION

C. A. WALDON /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 253-269 1981 refs

Avail: NTIS HC A19/MF A01

Wind machines are, inherently, generators of fatigue. This is true for all types and sizes. Testing at the Rocky Flats Small Wind Systems Test Center has shown that fatigue is the dominant mode of structural failure and its prediction the hardest task for the manufacturer. The objective of this paper is to present a technique, developed by the author, for measuring fatigue and predicting fatigue life for different wind regimes. Presented herein are techniques for locating high stress measuring points, obtaining data, using computer programs for calculating fatigue reduction, and predicting fatigue life. This paper also presents current work which extends the life prediction technique to other wind regimes. Author

N83-23739# Rockwell International Corp., Golden, Colo. Energy Systems Group.

ELECTRICAL SAFETY AND RELIABILITY TESTING AT RF WSTC

L. D. STATES /in Midwest Research Inst. Proc.: Small Wind Turbine Systems, 1981 p 271-280 1981

Avail: NTIS HC A19/MF A01

Two major areas of concern with Small Wind Energy Conversion Systems (SWECS) or other renewable energy systems that wish to interconnect with the existing utility grid have been identified -- electrical safety and reliability and power quality. Manufacturer's efforts to acquire system confidence in promoting safe and reliable SWECS/utility interconnections are discussed. B.W.

N83-23779# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany). Bereich Sondertechnik.

WIND ENERGY CONVERTER WITH HIGH-SPEED VERTICAL AXIS ROTOR AND STRAIGHT ROTOR BLADES Final Report, Sep. 1980

G. ZELCK Bonn Bundesministerium fuer Forschung und Technologie Nov. 1982 107 p /in GERMAN; ENGLISH summary

(BMFT-FB-T-82-201, ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 22,50

Complete documents for a wind energy converter with a vertical axis rotor and straight blades (H-rotor) were developed. The 2 blade rotor with rigid and rectangular air foils in wooden construction reaches the nominal output of 75 KVA from 11.4 m/sec. wind velocity onwards. The development activities are supported by wind tunnel and component tests. The final design selected was

based upon previous development work. Trade offs show that the design is more advantageous compared to other designs. The use of wood as a material for the rotary and horizontal blade supports gives positive result. E.A.K.

N83-23780# Deutsche Forschungsanstalt fuer Hubschrauber und Vertikallufttechnik, Stuttgart (West Germany). Inst. fuer Bauwesen- und Konstruktionsforschung.

DEVELOPMENT OF A WIND CONVERTER AND INVESTIGATION OF ITS OPERATIONAL FUNCTION. PART 1: TECHNICAL DESCRIPTION OF THE WIND ENERGY CONVERTER Final Report, Apr. 1981

J. P. MOLLY and R. STEINHEBER Bonn Bundesministerium fuer Forschung und Technologie Nov. 1982 60 p /n GERMAN; ENGLISH summary 4 Vol. (BMFT-FB-T-82-204; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 12,50

A 10 kW wind energy converter was developed by using as far possible standard serial production parts. The design criteria and the description of the essential machinery components of the MODA 10 wind energy converter are discussed. For some special load cases the safety calculation of the important components is shown. The blade control system which qualified for small wind energy converters, is explained. Weight and cost of the MODA 10 are considered. S.L.

N83-23781# Deutsche Forschungsanstalt fuer Hubschrauber und Vertikallufttechnik, Stuttgart (West Germany). Inst. fuer Bauwesen- und Konstruktionsforschung.

DEVELOPMENT OF A WIND ENERGY CONVERTER AND INVESTIGATION OF ITS OPERATIONAL FUNCTION. PART 2: AERODYNAMICS AND CALCULATION OF LOADS Final Report, Apr. 1981

A. KUSSMANN, O. STORM, and W. WEBER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 62 p refs /n GERMAN; ENGLISH summary 4 Vol. (BMFT-FB-T-82-205; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 13

The optimum design approach to wind rotor blades, and the special blade design to fit with a 10 kW horizontal axis wind energy converter are shown. The calculated performance data are given in power/blade pitch angle and c_p/λ diagrams. According to a set of defined load cases, critical load conditions were considered. Results of these load computations are presented as time history graphs and as wind velocity related diagrams, serving as basic data in component structural design. S.L.

N83-23782# Deutsche Forschungsanstalt fuer Hubschrauber und Vertikallufttechnik, Stuttgart (West Germany). Inst. fuer Bauwesen- und Konstruktionsforschung.

DEVELOPMENT OF A WIND ENERGY CONVERTER AND INVESTIGATION OF ITS OPERATIONAL FUNCTION. PART 3: DESIGN OF THE ROTORBLADE, PRODUCTION AND LOADING TESTS Final Report, Apr. 1981

D. MUSER and T. PREUSS Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 171 p refs /n GERMAN; ENGLISH summary 4 Vol. (BMFT-FB-T-82-206; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 33,50

The development of the rotor blade, its production and the loading tests are discussed. First the load assumptions are defined and different possibilities for the construction of the blade attachment and the blade itself are studied. Several rotor blades with partial different structural design characteristics were produced and investigated in extensive loading tests. Additionally tests were carried out on static vibration behavior, lightning protection, impact behavior and temperature measurements. A rotor blade for the 10 kW-wind energy converter was investigated. S.L.

N83-23783# Deutsche Forschungsanstalt fuer Hubschrauber und Vertikallufttechnik, Stuttgart (West Germany). Inst. fuer Bauwesen- und Konstruktionsforschung.

DEVELOPMENT OF A WIND ENERGY CONVERTER AND INVESTIGATION OF ITS OPERATIONAL FUNCTION. PART 4: TEST SETUP AND RESULTS OF MEASUREMENT Final Report, Apr. 1981

S. ARMBRUST and J. P. MOLLY Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 48 p refs /n GERMAN; ENGLISH summary 4 Vol. (BMFT-FB-T-82-207; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 10

Measurements made during test operations at the MODA.10 plant as well as at a 25 years old 6 kW wind energy converter are presented. The test arrangements, measurement results of both wind energy converters, and the experience gained are described. S.L.

N83-23790# Kraftwerk Union A.G. Reaktortechnik, Erlangen (West Germany). Aktiengesellschaft.

INCREASE OF THE OVERALL PLANT EFFICIENCY AND ELECTRICAL POWER OF EXISTING STEAM TURBINE POWER PLANTS BY CONVERSION TO COMBINED GAS AND STEAM CYCLE POWER PLANTS Final Report, Feb. 1982

A. KNIPFER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1982 205 p refs /n GERMAN; ENGLISH summary (BMFT-FB-T-82-237; ISSN-0340-7608) Avail: NTIS HC A10/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 36

In the case of a combined gas and steam cycle power plant in which an existing steam turbine is connected to a gas turbine, the GT exhaust heat may be utilized in the steam turbine. Two possibilities are investigated for the utilization of this exhaust heat. Either the exhaust gas preheats the feedwater of the steam turbine cycle or it is used in the boiler as combustion air. The findings indicate that overall plant efficiency can be increased by up to 4% as compared with the separate arrangement of gas turbine and steam turbine plants. The power gain is as much as 15%. The calculation of economic effectiveness indicates that only the variant incorporation exhaust gas preheating of the feedwater is economically effective. S.L.

N83-23801# Department of Energy, Washington, D. C. **PROCEEDINGS OF THE DOE HEAT PUMP CONTRACTORS' PROGRAM INTEGRATION MEETING**

Mar. 1982 238 p refs Meeting held in McLean, Va., 2-4 Jun. 1981 css Assistant Secretary for Conservation and Renewable Energy. (DE82-012370; CONF-810672) Avail: NTIS HC A11/MF A01

An appropriate forum for the exchange of technical and programmatic information and for the stimulation of mutual awareness in heat pump technology programs and projects was provided. The heat pump, a device that moves heat from a region of low temperature to a region of higher temperature, is highly adaptable to a variety of energy sources and end use energy needs of interest to various research and development.

N83-23803# Brookhaven National Lab., Upton, N. Y. **THE CHEMICAL HEAT PUMP PROGRAM. AN OVERVIEW**

A. MEZZINA /n DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 20-22 Mar. 1982 refs Avail: NTIS HC A11/MF A01

A brief overview of the Chemical Heat Pump Program is presented. Program background, rationale, technology description, and research and development needs are addressed. Chemical heat pumps comprise reversible reactions which can be driven by low grade heat. Thermal energy is absorbed in one direction and liberated in the reverse direction: thus, serving as a basis for system designs applicable to space conditioning or process heat management and offering the capability for high density energy storage as an integral part of the system. S.L.

N83-23815# Mechanical Technology, Inc., Latham, N. Y.
THE DESIGN OF AN OPEN RANKINE-CYCLE INDUSTRIAL HEAT PUMP

D. W. CHAUDOIR and H. M. LEIBOWITZ /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 89-95 Mar. 1982 refs

Avail: NTIS HC A11/MF A01

An open Rankine cycle heat pump is ideally suited for producing low pressure industrial process steam. Because steam serves as both the heat pump motive fluid and process fluid, the system achieves a unique simplicity and versatility. No intermediate refrigerant fluid exists for which to construct a process interface or impose a temperature limit. Interface components such as the heat pump condenser are not required. Moreover, the use of water vapor eliminates toxicity and flammability risks inherent with most closed cycle heat pump fluids. The control strategy is simple. Low pressure (subatmospheric) water vapor, generated by flashing steam at a temperature below that of the waste stream, is compressed to the process pressure and temperature by an electric motor driven, multistage compressor train. S.L.

N83-23817# United Technologies Research Center, East Hartford, Conn.

CONCEPTUAL DESIGN OF LARGE SCALE HEAT PUMP FOR CENTRAL ENERGY MANAGEMENT SYSTEM

R. W. BASS, A. M. LANDERMAN, and F. R. BIANCARDI /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 97-100 Mar. 1982

(Contract DE-AC09-77ET-12866)

Avail: NTIS HC A11/MF A01

An analytical study was undertaken to identify specific power generation and heat pump requirements for low-temperature waste heat recovery from government, utility and industrial sources, develop techniques needed to evaluate the performance and cost characteristics of various power system and heat pump options, and perform economic analyses on selected designs. Distinct waste heat sources and industrial end-uses were selected as representative applications and used for heat pump design specifications. Two of these applications typify large sources of waste heat and collocated industrial park end-uses while the remaining four represent in-plant industrial sources and end-uses. Rankine-cycle heat pump configurations and working fluid options were assessed and four configurations were selected on the basis of cost and performance for further study. Five different prime movers were examined as potential compressor drivers and gas turbines and diesels were selected on basis of high overall performance. A similar design assessment was performed for power recovery systems. A conceptual design of an economically attractive central energy management system for use at an industrial park located near by the Portsmouth gaseous diffusion plant is presented. Author

N83-23818# AirResearch Mfg Co., Torrance, Calif.

BRAYTON-CYCLE HEAT PUMP FOR SOLVENT RECOVERY

G. E. LIMBERG /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 101-104 Mar. 1982

(Contract DE-AC03-78CS-40005)

Avail: NTIS HC A11/MF A01

The solvent-using industries are lagging in recognizing the impact of the recently accelerated fuel price increases, and studies show that solvent recovery is an excellent means of reducing these costs. The Federal Clean Air Act requiring that more stringent clean air emission levels be implemented by December 31, 1982, is another incentive for these industries to enhance solvent recovery. The versatility of the Brayton cycle allows it to be integrated into a variety of processes, and considerable energy and cost savings can accrue over those obtainable with the normally used carbon-steam desorption solvent recovery systems. The annual energy savings to be realized by installing an 8000-cfm Brayton-cycle system at the demonstration site is approximately 56 x 10 to the 9th power Btu/yr and simple cost pay backs of less than 1 yr are achievable. The estimated market potential for the Brayton cycle in 1980 in the U.S. is the removal of 6.3 million

ions of volatile solvents (56 percent of the estimated recoverable solvents). The potential net energy savings is 0.11 quads better than for a carbon-steam desorption system. Author

N83-23821# General Electric Co., Philadelphia, Pa.
DEVELOPMENT AND DEMONSTRATION OF A STIRLING/RANKINE HEAT ACTIVATED HEAT PUMP

R. C. MEIER /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 118-123 Mar. 1982

(Contract DE-AC02-77CS-20043)

Avail: NTIS HC A11/MF A01

The current Phase II program includes the development of an engineering prototype heat activated heat pump, followed by the development and field testing of the engineering prototype was completed in early 1979. All of the components and subsystems met their performance goals except for the Stirling engine. The engine achieved an efficiency of 26%, versus a goal of 30%. Empirical data from the engineering prototype was then used to design the residential unit prototype, using a third order simulation model developed for the engine/compressor. Development and testing of the system components and the combustor/engine/compressor subsystem have been completed, preparations for laboratory tests of the complete residential unit prototype system are underway, and installation preparations at the field test site are nearly completed. The prototype residential unit components met their goals, except again for the Stirling engine. The engine achieved indicated power and efficiency values of 2.8 Kw and 27%, versus goals of 3.2 Kw and 33%, respectively. Author

N83-23822# Sunpower, Inc., Athens, Ohio.

DUPLEX STIRLING GAS FIRED HEATING ONLY HEAT PUMP

W. BEALE /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 127-129 Mar. 1982 refs

Avail: NTIS HC A11/MF A01

In phase I the Duplex Stirling Gas fired Heat Pump was analyzed with the aid of the Sunpower third order simulation and optimization code and found to show heating COP of 1.7 at the rating point of 8 C (17 F) with a heat delivery of 10 kW. Also it was found that a direct heat exchange between working fluid and source and sink air was consistent with high COP in the heat pump, thus eliminating the need for an intermediate heat transfer fluid and its associated pumps and controls. Further, it was demonstrated in the simulation that the heat engine power output could be matched to the heat pump load over the range of source temperatures without need of complex control systems. Cost estimates, along with COP figures from the analysis indicated a payback time of 2 to 4 years in completion with existing combustion heating systems in northern climates. Author

N83-23823# Mechanical Technology, Inc., Latham, N. Y.

FREE-PISTON STIRLING ENGINE TECHNOLOGY DEVELOPMENT

G. R. DOCHAT /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 130-133 Mar. 1982 refs

Avail: NTIS HC A11/MF A01

The program will utilize the Technology Demonstrator Engine system as a test bed to evaluate specific loss mechanisms within the engine during operation. This will provide meaningful information and test data to increase understanding of free-piston operation, and will be of benefit to application development programs for heat-activated heat pumps, fluid pumps, engine generators, etc. The evaluation will include the current analytical procedures for calculating the specific losses, perform a series of tests designed to isolate each loss, comparison of actual changes in engine performance with predicted change, and in engine performance with predicted change, and to determine the adequacy of present analytical methods. Recommendations to improve overall engine/system performance and/or analytical methods will be made. L.F.M.

N83-23824# General Electric Co., Philadelphia, Pa. KINEMATIC STIRLING ENGINE POWER SYSTEM DEVELOPMENT AND DEMONSTRATION

J. A. BLEDSOE /In DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 134-138 Mar. 1982 refs
(Contract DE-AC01-76ET-32002)
Avail: NTIS HC A11/MF A01

Although the original program was redirected to a technology demonstration program in 1978, the emphasis on the engine development and fabrication continued as planned. All major components of the system completed the design and documentation phase. Major components and subsystems required for engine test all met their performance goals. The engine achieved an efficiency of 28.6% with 3800 watts heat delivered to the engine as compared with the 30% predicted value at the design point conditions. Total engine operating time was over 500 hours and post test inspections revealed no major problems with the hardware. One minor problem was associated with the lubrication system which is easily corrected. Author

N83-23826# Battelle Columbus Labs., Ohio. CONDUCT A STATE-OF-THE-ART SURVEY OF EXISTING KNOWLEDGE FOR THE DESIGN OF GROUND-SOURCE HEAT PUMPS

D. A. BALL /In DOE Proc. of the DOE Heat Pump Conductors' Program Integration Meeting p 155-160 Mar. 1982 refs
Avail: NTIS HC A11/MF A01

Horizontal serpentine coils have been and are at present the most common coil configuration. Best design data exist for horizontal coils in heating only applications with moist soil. Applications in dry soil or where significant summer cooling is required are not as well understood at this time. A seasonal performance factor of about 3.0 can be expected for a properly designed and installed residential ground-coupled heat-pump system. Long-term durability of buried steel and copper tubing has been demonstrated. Life expectancy of thin-walled polyethylene tubing in the heating-only application is expected to be equally as good: however, present experience is limited to less than five years. In the cooling application with heat-rejection temperatures exceeding 100 F, some cracking has been experienced upon subsequent cool-down for heating operation due to localized stresses induced by conformity of the tubing to bedding material (stones) when hot. Receding of the soil from the pipe after a period of several years was experienced in the late 1940's. An understanding of this phenomenon may be crucial to the long-term operating success of these systems. L.F.M.

N83-23830# Foster-Miller Associates, Inc., Waltham, Mass. LOW TEMPERATURE WASTE HEAT UTILIZATION CHILLER SYSTEM

S. HYNK /In DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 201-205 Mar 1982
Avail: NTIS HC A11/MF A01

The preliminary system design is complete; standard components (including condenser and compressor) have been selected and special components (such as rotary expander valve and boiler feed pump) have been designed. The boiler feed pump has been tested, and expander testing is underway. The design and construction of a complete demonstration system has begun. Author

N83-23831# Dunham-Bush, Inc., West Hartford, Conn. MULTIPLE SLIDE SCREW COMPRESSION

D. N. SHAW /In DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 214-216 Mar. 1982
(Contract DE-AC03-79CS-30035)
Avail: NTIS HC A11/MF A01

The objective of this project is to develop the best possible compressor for use in Series Solar Heat Pump Systems. The compressor must be able to operate at extremely high efficiency levels from a compression ratio as low as 1.5 up to compression ratio as high as 6.5. The compressor must have the capability to efficiently adjust to the widely varying inlet flow requirements as

dictated by the operating conditions of the Series Solar Heat Pump System. Prototype design has been completed yet some simplification redesign is now taking place. L.F.M

N83-23853# Marquette Univ., Milwaukee, Wis. CONCENTRATION CELLS FOR COMBUSTION IMPROVEMENT. REACTION RATE IN A ZIRCONIUM-YTRIA SOLID-ELECTROLYTE FUEL CELL Final Report

R. GAGGIOLI and D. W. WALKER Nov. 1982 100 p refs
(Contract DE-FG01-78ET-12231)
(DE83-002773, DOE/ET-12231/T1) Avail: NTIS HC A05/MF A01

The reaction rate for fuel oxidation in a solid electrolyte fuel cell of zirconium doped with yttria is discussed. An experimental apparatus was developed for measuring cell current and voltage across a load at several fuel and air flow rates at temperatures in the neighborhood of 950 C. The resultant data was used to deduce two correlations between the reaction rate and chemical affinity. It was found that the reaction rate was essentially independent of the flow rates, over the flow ranges covered by the reliable experimental runs. Another important conclusion following from the experimental results is that, under normal operating conditions, the available energy consumption associated with fuel oxidation kinetics cannot be neglected. For example, close to maximum power, the oxidation consumption is 200 times the electrolyte resistance consumption. These results are not only valuable in themselves, but are utilized in a computer model for simulating the performance of arrays of solid electrolyte fuel cells, as well as the utilization of such arrays for improving the performance of conventional power plants. DOE

N83-23862# Arizona Public Service Co., Phoenix. DIRECT FLASH STEAM GEOTHERMAL POWER PLANT ASSESSMENT Final Report

T. E. ALT Jan. 1982 83 p refs
(Contract EPRI PROJ. 1195-1)
(DE82-902096; EPRI-AP-2162) Avail: NTIS HC A05/MF A01

The objective was to analyze the capacity and availability factors of an operating direct flash geothermal power plant. System and component specifications, operating procedures, maintenance history, malfunctions, and outage rate are discussed. The plant studied was the 75 MW(e) geothermal power plant at Cerro Prieto, Mexico, for the years 1973 to 1979. To describe and assess the plant, the project staff reviewed documents, visited the plant, and met with staff of the operating utility. The high reliability and availability of the plant was documented and actions responsible for the good performance were identified and reported. The results are useful as guidance to US utilities considering use of hot water geothermal resources for power generation through a direct flash conversion cycle. DOE

N83-23866# Little (Arthur D.), Inc., Cambridge, Mass. WIND ENERGY CONVERSION SYSTEM ANALYSIS MODEL (WECSAM) COMPUTER PROGRAM DOCUMENTATION

W. T. DOWNEY and P. L. HENDRICK Golden, Colo. Solar Energy Research Inst Jul 1982 78 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-021014; SERI/SP-19136-4) Avail: NTIS HC A05/MF A01

Described is a computer-based wind energy conversion system analysis model (WECSAM) developed to predict the technical and economic performance of wind energy conversion systems (WECS). The model is written in CDC FORTRAN V. The version described accesses a data base containing wind resource data, application loads, WECS performance characteristics, utility rates, state taxes, and state subsidies for a six state region (Minnesota, Michigan, Wisconsin, Illinois, Ohio, and Indiana). The model is designed for analysis at the county level. The computer model includes a technical performance module and an economic evaluation module. The modules can be run separately or together. The model can be run for any single user-selected county within the region or looped automatically through all counties within the region. In addition, the model has a restart capability that allows the user to

modify any data-base value written to a scratch file prior to the technical or economic evaluation. DOE

N83-23884# Colorado Univ., Boulder.
SENSITIZATION AND QUENCHING IN THE CONVERSION OF LIGHT ENERGY INTO CHEMICAL ENERGY Annual Progress Report, 1 Feb. 1982 - 31 Jan. 1983
 S. J. CRISTOL Aug. 1982 11 p refs
 (Contract DE-AC02-79ER-10366)
 (DE82-0211592; DOE/ER-10366/4) Avail NTIS HC A02/MF A01

The photorearrangements of several dibenzobarrelene to dibenzo cyclo octatetraenes (singlet reactions), the quenching of that process, and the accompanying sensitization to give dibenzo semibull valenes, as mediated by acetone concentration was studied. This work demonstrated, the plausibility of a relay mechanism in which an excited singlet of a reactant, produced by direct irradiation, is quenched, the quencher intersystem crosses to its triplet state and then retransfers energy to the reactant molecule to give its triplet, which does its own chemistry. Work aimed at determining substituent effects on excited state reaction rate constants and reactivities was continued. Work on excitation transfer geometry and on oxidation potential requirements in excited bichromophoric molecules is in progress as is work on lifetime measurements of certain excited singlet and triplet states. DOE

N83-23885# MelTek Associates, Inc., Shoreview, Minn
WIND DRIVEN LIGHTING DEVICE Final Technical Report
 C J MICHAUD 30 Apr. 1982 37 p
 (Contract DE-FG02-80R5-10237)
 (DE83-001876; DOE/R5-10237/1) Avail: NTIS HC A03/MF A01

The design and development of a prototype model of a wind driven lighting device, to be installed similar to a post light, for home and farmyard lighting are described. Several turbines were tested. Work on an alternator to produce power at wind speeds as low as 8 mph is described. DOE

N83-23890# Jacobson (Ray O.), Pengilly, Minn
REPORT OF INVESTIGATION FOR HYDROELECTRIC GENERATION Final Report
 R. O. JACOBSON 16 Nov. 1982 72 p refs
 (Contract DE-FG02-81R5-10311)
 (DE83-004798; DOE/R5-10311/2) Avail: NTIS HC A04/MF A01

The lowering cost of electricity to consumers by utilizing local rivers for the generation of power was studied. Northern Minnesota has many rivers and streams but has a relatively flat terrain. The principal power company of the area, Minnesota Power, generates electricity from the St. Louis, Mississippi, Crow Wing, and Kawishiwi Rivers. Existing dam sites were studied. Correlating the costs with the sites, it is found that the development of any of the selected sites is not feasible. The high cost of new generating equipment and the high interest rates make the generation of power from the low head/low flow sites uneconomical. DOE

N83-23895# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PERFORMANCE AND STABILITY OF THE MIST-LIFT PROCESS FOR OPEN-CYCLE OCEAN THERMAL ENERGY CONVERSION
 R. DAVENPORT and D. JOHNSON Sep. 1982 15 p refs
 Presented at the ASME Winter Ann. Meeting, Phoenix, Ariz., 14-19 Nov. 1982
 (Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
 (DE83-0000450; SERI/TP-252-1596; CONF-821101-11) Avail: NTIS HC A02/MF A01

The mist lift process for open cycle OTEC was studied. A multiple drop size model that considers collisions and coalescence of drops indicate that drop growth is rapid. An improved model that includes breakup of drops and coalescence indicates that drops tend to grow rapidly to a mean diameter of about 0.5 mm and that collisions prevent the drops from growing much larger than a few millimeters. It is indicated that the mist lift process will

perform under a variety of conditions. Considerations for the design of mist lift tube are identified. Results of a transient mist lift model indicate that the mist flow process is stable to perturbations in operating conditions, as long as the conditions remain within the steady state operational envelope for the particular mist lift tube. DOE

N83-23944# Rockwell International Corp., Golden, Colo. Energy Systems Group.
WIND SYSTEMS TECHNICAL NOTES: 1979-1980
 S. A. SHULER, comp and J. V. STAFFORD, ed Feb. 1982 198 p refs
 (Contract DE-AC04-76DP-03533)
 (DE82-016358, RFP-3339) Avail: NTIS HC A09/MF A01

Technical Notes produced by the Rocky Flats Wind Systems Program in 1979-1980 to document specialized tests of small wind systems and other investigations are presented. Subjects include: vibration, dynamometer, and controlled velocity tests of 1 to 2 kW and 8 kW prototype wind systems, the use of induction generators; data collection and reporting procedures; analog-to-digital data conversion; optical rpm sensors, alternator frequency monitoring, and air density adjustments. A separate abstract was prepared for each of the technical notes. DOE

N83-23945# United Technologies Research Center, East Hartford, Conn
UTRC 15-KW WIND-SYSTEM DEVELOPMENT. PHASE 1, DESIGN AND ANALYSIS. VOLUME 2: TECHNICAL REPORT
 R. B. TAYLOR and M. C. CHENEY Dec. 1981 181 p refs 2 Vol.
 (Contract DE-AC04-76DP-03533)
 (DE83-021710; PFP-3331-2) Avail: NTIS HC A09/MF A01

A description is given of the design of a 15-kW wind turbine. The wind turbine employs the UTRC Composite Bearingless Rotor Concept in conjunction with a passive pendulum control system which controls blade pitch for start-up, efficient power generation, and high-speed survivability. Also included is a summary of experimental material and component tests which were performed in support of the wind turbine design. Studies of system reliability, maintainability, availability and safety are reported and an estimate of the cost-of-energy is also made for a production wind system. DOE

N83-23946# United Technologies Research Center, East Hartford, Conn.
UTRC 15-KW WIND-SYSTEM DEVELOPMENT. PHASE 1, DESIGN AND ANALYSIS. VOLUME 1: EXECUTIVE SUMMARY
 R. B. TAYLOR and M. C. CHENEY Dec. 1981 19 p 2 Vol
 (Contract DE-AC04-76DP-03533)
 (DE82-021709, RFP-3331-1) Avail: NTIS HC A02/MF A01

The wind system consists of a horizontal-axis, two-bladed, down-wind rotor, which is free in yaw and is supported by a cantilevered free standing tower. Control of blade pitch is provided by a passive system consisting of pendulums which are sensitive to centrifugal forces created by rotor rotation. Rotor speed control in high winds is achieved by blade stall and the system is designed to withstand gusts up to 56 m/s. The design of the electrical system, head assembly, and nacelle and the tower design and erection are described briefly. Also discussed is the system analysis, consisting of predicted power output and annual energy capture, cost of energy, analysis of loads and stresses, availability, and safety. Experimental tests were performed in support of the design in the areas of materials evaluation and component testing. DOE

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N83-23947# Kohring (Gene W.), Hamilton, Ohio.
FEASIBILITY STUDY OF WIND-GENERATED ELECTRICITY FOR RURAL APPLICATIONS IN SOUTHWESTERN OHIO Final Technical Report
G. W KOHRING 1982 29 p
(Contract DE-FG02-80R5-10242)
(DE82-021596, DOE/R5-10242/T1) Avail. NTIS HC A03/MF A01

The parameters associated with domestic production of wind generated electricity for direct use by small farms and rural homes in the southwestern Ohio region are discussed. The project involves direct utility interfaced electricity generation from a horizontal axis, down-wind, fixed pitch, wind powered induction generator system. Goals of the project are to determine: the ability to produce useful amounts of domestic wind generated electricity in the southwestern Ohio region; economic justification for domestic wind generated electrical production, and the potential of domestic wind generated electricity for reducing dependence on non-renewable energy resources in the southwestern Ohio region DOE

N83-23981# California Univ., Berkeley Lawrence Berkeley Lab Marine Sciences Group
ENVIRONMENTAL MONITORING AT KAHE POINT, OAHU, HAWAII FOR OTEC PILOT PLANT DEVELOPMENT
A. T. DENGLER, V. HARMS, E. O. HARTWIG, M. S. QUINBY-HUNT, P. WILDE, and L. LEWIS (DOE, Washington) Aug 1982 8 p Presented at the Marine Technol Soc and Geol Soc. of Am Conf on Oceans, Washington, D.C., 20 Sep. 1982 (Contract DE-AC03-76SF-00098)
(DE82-020979; LBL-14799; CONF-820926-4) Avail. NTIS HC A02/MF A01

Two 40 MWe ocean thermal energy conversion (OTEC) pilot plant programs are in the initial phase of development near Kahe Point, Oahu, Hawaii. Two options are examined (1) a shelf seated artificial island, connected via a causeway to Oahu, using stainless steel heat exchangers, with the thermal resource enhanced by effluent from a nearby power plant, ammonia working fluid and biocide (chlorine) cleaning; and (2) a shelf mount tower 1 mile off shore using submerged aluminum heat exchangers, R-22 working fluid, and slurry cleaning with biocide (chloride) backup. Environmental technical requirements are described including: siting criteria, environmental design, and operational criteria; thermal resource evaluation and variability, physical, chemical, and biological data requirements; and regulatory requirements DOE

N83-24317# Los Alamos Scientific Lab., N. Mex.
SHIELDING CONSIDERATIONS FOR ADVANCED SPACE NUCLEAR REACTOR SYSTEMS
J. P. ANGELO, JR. (Florida Inst. of Tech.) and D. BUDEN 1982 19 p refs Presented at the IEEE Conf on Nucl. and Space Radiation Effects, Las Vegas, Nev., 20-12 Jul 1982 (Contract W-7405-ENG-36)
(DE82-019565; LA-UR-82-2002; CONF-820708-8) Avail. NTIS HC A02/MF A01

To meet the anticipated future space power needs, the Los Alamos National Laboratory is developing components for a compact, 100 kW/sub e/-class heat pipe nuclear reactor. The reactor uses uranium dioxide (UO₂) as its fuel, and is designed to operate around 1500 K. Heat pipes are used to remove thermal energy from the core without the use of pumps or compressors. The reactor heat pipes transfer thermal energy to thermoelectric conversion elements that are advanced versions of the converters used on the enormously successful Voyager missions to the outer planets. Advanced versions of this heat pipe reactor could also be used to provide megawatt-level power plants. The status of this advanced heat pipe reactor is reviewed and the radiation environments and shielding requirements for representative manned and unmanned applications are explored DOE

N83-24357# Sandia Labs., Albuquerque, N. Mex.
THE CHARACTERISTICS OF LIGHT-ION-BEAM FUSION SYSTEMS
C. W. MENDEL, JR. 1982 19 p refs Presented at the Workshop on Diagn. for Fusion Reactor Conditions, Varenna, Italy, 6 Sep. 1982 (Contract DE-AC04-76DP-00789)
(DE82-021080, SAND-82-1251C, CONF-820944-3) Avail. NTIS HC A02/MF A01

The conditions for light ion beam fusion are extreme, involving large energies and short times, and the diagnostics needed for experiments are generally very different from those in other fusion fields. The only closely related field is that of laser fusion where the energies are smaller, but the times are even shorter. Typical particle beam fusion conditions require power densities of the order of 10 to the 14th power watts/sq cm on targets of 5 to 10 mm diameter. The beam pulse should be about 10 ns long at the target. The first lecture describes the state of present particle beam pulser technology, the diode concepts which are used in converting the electromagnetic pulse to particle beam energy, and the transport and focusing of the beam DOE

N83-24768*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COUPLING AN INDUCTION MOTOR TYPE GENERATOR TO A-C POWER LINES Patent Application
F. J. NOLA, inventor (to NASA) 31 Mar. 1983 18 p
(NASA-CASE-MFS-25302-2; US-PATENT-APPL-SN-481086)
Avail. NTIS HC A02/MF A01 CSCL 09A

A system for connecting an induction motor type generator to an AC power line is described in which an electronic switch is controlled and regulated to turn on at a relatively late point in each half cycle of its operation. The energizing power supplied by the line to the induction motor type generator is decreased and the net power delivered to the line is increased. NASA

N83-25044# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.
PERFORMANCE OF TORNADO-TYPE WIND TURBINES WITH RADIAL INFLOW SUPPLY
C. T. HSU and H. IDE Sep 1982 33 p refs
Avail. NTIS HC A03/MF A01

Wind tunnel tests were conducted for the performance of tornado-type wind turbines with radial inflow supply from the incoming wind. It was shown that the radial inflow supply was necessary for intensifying a vortex in the wind collecting tower and, consequently, for enhancing the power efficiencies. A maximum power efficiency of 3.8 was obtained for a circular-shaped tower as compared to the value of 0.4 for the conventional windmills. Author

N83-25060# Virginia Univ., Charlottesville. Applied Electrochemistry Lab.
SELECTION AND EVALUATION OF MATERIALS FOR ELECTROCHEMICAL ENERGY CONVERSION DEVICES: ELECTROCHEMICAL EVALUATION OF NICKEL WHISKER ELECTRODES
J. D. HANSEN, G. E. STONER, G. L. CAHEN, JR., and L. L. SCRIBNER /in MCC Associates, Inc. Proc of the 6th Ann Thermal and Chem. Storage Contractors' Rev. Meeting p 30-34 Feb 1982 refs
Avail. NTIS HC A17/MF A01

A method was developed and refined to measure effective surface area of planar electrodes. The method yields reproducible and consistent results. Highly accurate determinations of exchange current densities for hydrogen evolution on nickel plates and nickel whiskers indicate that there is no significant difference due to the unique microstructure of whiskers. Supportive evidence for reversible hydrogen absorption into nickel plate and nickel whiskers is obtained by monitoring changes in apparent capacitance during absorption and desorption. Author

N83-25067# TRW, Inc., McLean, Va. Energy Engineering Div.
CHEMICAL HEAT PUMP COST EFFECTIVENESS EVALUATION
 W. R. STANDLEY In MCC Associates, Inc. Proc. of the 6th
 Ann Thermal and Chem. Storage Contractors' Rev. Meeting p
 99-105 Feb. 1982 refs
 Avail: NTIS HC A17/MF A01

The cost-effectiveness and energy-effectiveness of existing chemical heat pump (CHP) concepts is compared with a baseline of conventional energy technologies and a group of near-term emerging energy technologies with which CHPs are expected to compete. The analysis is structured to evaluate these systems functioning as the primary space conditioning unit of both a 'standard' single-family detached home and a 'representative' commercial building. Each HVAC system and application is analyzed in each of two locations in the United States, the southwest (Albuquerque, NM) and the northeast (Boston, MA). In addition, the CHPs are evaluated in a 'representative' industrial waste heat upgrading application, and compared to potentially-competitive technologies for industrial 'heat pumping' L.F.M.

N83-25114# Naval Academy, Annapolis, Md Dept. of Naval Systems Engineering.
PERFORMANCE OPTIMIZATION OF A PNEUMATIC WAVE ENERGY CONVERSION DEVICE Final Report, 1981 - 1982
 S. W. SURKO 26 Aug. 1982 83 p refs
 (AD-A124295; USNA-TSPR-120) Avail: NTIS HC A05/MF A01
 CSCI 10B

The purpose of this study was, for the first time, to optimize the performance of a pneumatic wave energy conversion device. The experiments of Jolly and Newmaster (1979) and Trop and Casey (1980) left a capture chamber and turbine for further investigation. To optimize the system performance the turbine had to be first analyzed so that its power performance curves could be determined. These curves were needed to help define the possible overall performance of the system, and for the impedance matching of the system necessary for performance optimization. With this knowledge, an appropriate generator was purchased and a generator-turbine linkage designed and built. The completed system was then analyzed in the 380 ft wave tank at the U.S. Naval Academy to establish its optimum performance. From the research it is clear that pneumatic wave energy conversion is a promising concept. With several hundred of these devices situated some 100 km off the coast of the Pacific Northwest each device would be producing from 50 to 200 kW which would be transferred back to shore. GRA

N83-25127# Stappenhorst (F. W. E.), Inc., Pointe Claire (Quebec)
GOODYEAR LAKE HYDROELECTRIC GENERATING STATION REDEVELOPMENT Final Report
 Oct. 1982 34 p
 (Contract DE-FC07-79RA-23211)
 (DE83-004753; DOE/RA-23211/4) Avail: NTIS HC A03/MF A01

The Goodyear Lake low-head hydropower plant resulted from the rehabilitation of an old dam. The project construction costs, which included a 17% overrun from original cost estimates due chiefly to extraordinary rates of inflation are discussed. Operating costs and revenues are analyzed. DOE

N83-25131# Argonne National Lab., Ill.
ADVANCED-FUEL-CELL DEVELOPMENT Progress Report, Oct. - Dec. 1980
 R. D. PIERCE, R. M. ARONS, J. T. DUSEK, A. V. FRAIOLI, G. H. KUCERA, J. W. SIM, and J. L. SMITH Jun. 1982 38 p refs
 (Contract W-31-109-ENG-38)
 (DE82-021146; ANL-81-67) Avail: NTIS HC A03/MF A01

The fuel cell research and development activities at Argonne National Laboratory (ANL) for the period October through December 1980. These efforts have been directed toward (1) developing alternative concepts for components of molten carbonate fuel cells, and (2) improving understanding of component

behavior. The principal focus has been on development of gamma-LiAlO₂ sinters as electrolyte structures. Green bodies were prepared by tape casting and then sintering beta-LiAlO₂; this has produced gamma-LiAlO₂ sinters of 69% porosity. In addition, a cathode prepared by sintering lithiated nickel oxide was tested in a 10-cm square cell. DOE

N83-25136# Argonne National Lab., Ill. Chemical Engineering Div.
ADVANCED-FUEL-CELL DEVELOPMENT Progress Report, Apr. - Jun. 1981

R. D. PIERCE, R. M. ARONS, J. T. DUSEK, A. V. FRAIOLI, G. H. KUCERA, J. W. SIM, and J. L. SMITH Aug. 1982 24 p refs
 (Contract W-31-109-ENG-38)
 (DE82-021272; ANL-82-40) Avail: NTIS HC A02/MF A01

Fuel cell research and development activities are described. The efforts are directed toward: (1) understanding of component behavior in molten carbonate fuel cells, and (2) developing alternative concepts for components. The principal focus was on the development of sintered gamma LiAlO₂ electrolyte supports, stable NiO cathodes, and hydrogen diffusion barriers. Cell tests were performed to assess diffusion barriers and to study cathode voltage relaxation following current interruption. DOE

N83-25148# Washington State Energy Office, Olympia.
DEVELOPING HYDROPOWER IN WASHINGTON STATE. VOLUME 2: AN ELECTRICITY MARKETING MANUAL
 J. W. JAMES and G. A. MCCOY Mar. 1982 180 p refs
 (Contract DE-FG06-80RO-01001)
 (DE82-017778; WAOENG-81-02-2) Avail: NTIS HC A09/MF A01

An electricity marketing manual for the potential small and micro-hydroelectric project developer within the state of Washington is presented. Public utility regulatory policies (PURPA) requires electric utilities to interconnect with and pay a rate based on their full avoided costs for the purchase of electrical output from qualifying small power production facilities. The determination of avoided costs, as business organizational considerations, utility interface concerns, interconnection requirements, metering options, and liability and wheeling are discussed. The utility responses are summarized, legislation which is of importance to hydropower developers and the powers and functions of the authorities responsible for enforcing the mandate of PURPA are described. DOE

N83-25150# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
WIND-ENERGY PROGRAM Quarterly Review.
 R. MITCHELL, R. J. NOUN, T. FLAIM, M. DEUTSCH, E. JACOBS, S. HOCK, H. SKLAR, and N. D. KELLEY May 1982 40 p
 (Contract DE-AC02-77CH-00178)
 (DE82-014199; SERI/PR-211-1589, QR-2) Avail: NTIS HC A03/MF A01

Progress on the wind energy tasks is summarized. program management and planning; WECS applications in nongenerating utilities, technical feasibility of stand-alone SWECS; WECS/storage assessment and options; WECS performance/value analysis; wind energy industry analysis; wind systems coordination; wind workshops; noise and television interference studies; and advanced and innovative wind energy concepts. DOE

N83-25151# Aerospace Systems, Inc., Burlington, Mass.
ASI/PINSON 1-KILOWATT HIGH-RELIABILITY WIND-SYSTEM DEVELOPMENT. PHASE 1: DESIGN AND ANALYSIS Executive Summary Report
 R. B. NOLL, N. D. HAM, H. M. DREES, and L. B. NICHOLS Mar. 1982 27 p
 (Contract DE-AC04-76DP-03533)
 (DE82-015600; RFP-3046-1) Avail: NTIS HC A03/MF A01

A high reliability version of a unique vertical axis machine called the Cycloturbine is a 15-ft diameter turbine with three straight 8 ft blades controlled by a tilt cam mechanism. The tilt cam mechanism controls blade cyclic pitch amplitudes in a manner similar to a

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helicopter swash plate. The electronic circuitry, consists of a voltage regulator and a power rectifier. Two transient protection networks are included, one on the tower for the alternator and the other to protect circuitry in the control building. The unique configuration of the Cycloturbine necessitated the development of aerodynamic, performance, and structural analyses to evaluate the design. A commercial Cycloturbine was instrumented and tested to verify the aerodynamic, performance and structural analyses. Author

N83-25152# Little (Arthur D.), Inc., Cambridge, Mass.
WIND-TURBINE-PERFORMANCE ASSESSMENT Interim Report

W A VACHON Jun 1982 131 p refs
(Contract EPRI PROJ. 1996-1)
(DE82-905281; EPRI-AP-2456, TSR-4) Avail: NTIS HC A07/MF A01

An updated summary of recent test data and experiences is reported from both federally and privately funded large wind turbine (WT) development and test programs, and from key WT programs in Europe. Progress and experiences on both the cluster of three MOD-2 2.5-MW WT's, the MOD-1 2-MW WT, and other WT installations are described. An examination of recent test experiences and plans from approximately five privately funded large WT programs in the United States indicates that, during machine checkout and startup, technical problems are identified, which require and startup, a number of technical problems are identified, which will require design changes and create program delays. Author

N83-25165# Oak Ridge National Lab., Tenn. Energy Div
A COMPARISON OF LABORATORY AND FIELD-TEST MEASUREMENTS OF HEAT-PUMP WATER HEATERS

W. P. LEVINS 1982 22 p refs Presented at the ACEEE 1982 Summer Study in Energy Efficient Buildings, Santa Cruz, Calif. 21-28 Aug. 1982

(Contract W-7405-ENG-26)
(DE82-020810; CONF-820849-2) Avail: NTIS HC A02/MF A01

After developing the heat pump water heater (HPWH), a field-test plan was implemented whereby 20 US utilities each received five units for a year test period. During the field tests, two of the prototype HPWHs identical to the field test units were tested in the laboratory. A comparison of the laboratory and the field test data was excellent on an overall basis but showed differences for parametric temperature sensitivities. Field test data for the effect of the HPWH on the house heating system were not only overly conclusive, but laboratory test data were used to analytically evaluate this effect. DOE

N83-25212# West Texas State Univ., Canyon. Alternative Energy Inst.

WIND-ASSIST IRRIGATION AND ELECTRICAL-POWER GENERATION Final Report

V. NELSON and K. STARCHER 13 Jul 1982 26 p refs
(Contract TENRAC EDF PROJ. 78-W-4-1)
(DE83-900882; TENRAC/EDF-071) Avail: NTIS HC A03/MF A01

A wind turbine is mechanically connected to an existing irrigation well. The system can be operated in three modes: electric motor driving the water turbine pump. Wind assist mode where wind turbine supplements power from the utility line to drive the water turbine pump. At wind speeds of 12 m/s and greater, the wind turbine can pump water (15 kW) and feed power (10 kW) back into the utility grid at the same time. Electrical generation mode where the water pump is disconnected and all power is fed back to the utility grid. The concept is technically viable as the mechanical connection allows for a smooth transfer of power in parallel with an existing power source. Minor problems caused delays and major problems of two rotor failures precluded enough operation time to obtain a good estimation of the economics. Because reliability and maintenance are difficult problems with prototype or limited production wind energy conversion systems, the expense of the demonstration project has exceeded the estimated cost by a large amount. DOE

N83-25333# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst
PROTECTING WIND ACCESS: A PRELIMINARY ASSESSMENT

R. J. NOUN and D. PERKINS-SMITH Jun. 1982 13 p refs
(Contract DE-AC02-77CH-00178)
(DE82-019128, SERI/TP-211-1647) Avail: NTIS HC A02/MF A01

The identification of suitable sites for large wind machine clusters, or wind farms, requires more than finding a location with an adequate wind resource were discussed. The affect of land use policies and regulations on the siting of wind system installations is considered. In particular, the issue of acquiring wind rights, or guaranteed access to the wind resource for electric power generation, will be vital to the development of wind energy. Several methods for acquiring and preserving access to the wind resource and for dealing with related land-use issues are examined. DOE

N83-25568# Los Alamos Scientific Lab., N. Mex
US PROGRAM IN HEAVY-ION FUSION

R. O. BANGERTER 1982 17 p refs Presented at the Symp. on Accelerator Aspects of Ion Fusion, Darmstadt, West Germany, 29 Mar. 1982

(Contract W-7405-ENG-36)
(DE82-015769, LA-UR-82-1192; CONF-820338-8) Avail: NTIS HC A02/MF A01

A national plan for heavy ion fusion research is outlined. The transfer of the heavy ion fusion program from the Defense Programs to the Office of Energy Research is discussed. DOE

N83-25625*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

FREE-PISTON STIRLING HYDRAULIC ENGINE AND DRIVE SYSTEM FOR AUTOMOBILES

D. G. BEREMAND, J. G. SLABY, R. C. NUSSLE, and D. MIAO Nov. 1982 28 p refs Presented at Automotive Technol. Develop. Contractor Coordination Meeting, Dearborn, Mich., 25-28 Oct 1982

(NASA-TM-82992; E-1421-3, NAS 1 15 82992) Avail: NTIS HC A03/MF A01 CSCL 13F

The calculated fuel economy for an automotive free piston Stirling hydraulic engine and drive system using a pneumatic accumulator with the fuel economy of both a conventional 1980 spark ignition engine in an X body class vehicle and the estimated fuel economy of a 1984 spark ignition vehicle system are compared. The results show that the free piston Stirling hydraulic system with a two speed transmission has a combined fuel economy nearly twice that of the 1980 spark ignition engine - 21.5 versus 10.9 km/liter (50.7 versus 25.6 mpg) under comparable conditions. The fuel economy improvement over the 1984 spark ignition engine was 81 percent. The fuel economy sensitivity of the Stirling hydraulic system to system weight, number of transmission shifts, accumulator pressure ratio and maximum pressure, auxiliary power requirements, braking energy recovery, and varying vehicle performance requirements are considered. An important finding is that a multispeed transmission is not required. The penalty for a single speed versus a two speed transmission is about a 12 percent drop in combined fuel economy to 19.0 km/liter (44.7 mpg). This is still a 60 percent improvement in combined fuel economy over the projected 1984 spark ignition vehicle. S.L.

N83-25844# Commission of the European Communities, Luxembourg.

RECORD OF WORK ON NOVEL ELECTROCATALYSTS FOR ADVANCED ELECTROLYSIS Final Report

L. MARTIN, J. DIETTE, M. PRIGENT, M. BERNARD, J. DEMARSY, and C. SELLIER Dec. 1982 92 p Transl. into ENGLISH from Inst. Francais du Petrole (France), report no 7068, 1981 109 p (PB83-144923; EUR-7068-EN) Avail: NTIS HC A05/MF A01 CSCL 07D

This study carried out jointly by IFP and SRTI aims at obtaining an electrolytic cell with a potential around 1.6 V in the 160-200C

temperature range. IFP have investigated the composition of the catalysts used and methods of applying them to the electrodes. Trials of short duration have been carried out at 80C and 1 A./sq cm current density; a physical-chemical examination of the electrodes has been made before and after use. SRTI have been concerned with the study of alkaline electrolysis up to 200C in aqueous medium, the optimization of electrode geometry and the activation of the electrodes by electrochemical processes. Endurance trials of several hundred hours have been carried out. Results have shown that catalytic activation of electrodes is an efficient method of improving electrolytic output. GRA

N83-26083# Aerodyne Dallas, Tex.
FUEL CONSUMPTION REDUCTION FOR DIESEL POWER GENERATOR SETS THROUGH THE APPLICATION OF AN ADVANCED TURBOCHARGER OPERATING AT CONSTANT SPEED Final Report, 30 Mar. - 8 Oct. 1982
 J. R. ARVIN Oct. 1982 50 p
 (Contract DAAK70-82-C-0070)
 (AD-A123846) Avail: NTIS HC A03/MF A01 CSCL 10B

The objective of the current research is to demonstrate that a 30KW-400Hz precision gen set, equipped with a VATN (variable area turbine nozzles) turbocharger, can comply with DoD gen set transient specifications. Heretofore poor turbocharger transient response (turbo lag) caused the turbocharged, DED gen set to lose frequency beyond acceptable DoD limits during an instantaneous change in load from 0 to full load. Engine operating conditions were calculated using a computer math model. The turbocharger, with controller, was installed on a four cylinder diesel engine and tested at the engine manufacturer's (White Engine Co.) facility. Fuel consumption data was used to further refine the engine math model. Calculations confirmed at least a 9% fuel savings for the 30KW-400Hz gen set. From the effort of this contract, it can be concluded that a DED precision gen set equipped with a VATN turbocharger can comply with DoD transient requirements. GRA

N83-26259*# Avco-Everett Research Lab., Mass.
PARAMETRIC STUDY OF POTENTIAL EARLY COMMERCIAL MHD POWER PLANTS. TASK 3: PARAMETER VARIATION OF PLANT SIZE Final Report
 F. A. HALS Sep. 1981 221 p refs
 (Contract DEN3-51; DE-AI01-77ET-710769)
 (NASA-CR-165445; DOE/NASA/0051-3; NAS 1.26:165445)
 Avail: NTIS HC A10/MF A01 CSCL 10B

Plants with a nominal output of 200 and 500 MWe and conforming to the same design configuration as the Task II plant were investigated. This information is intended to permit an assessment of the competitiveness of first generation MHD/steam plants with conventional steam plants over the range of 200 to 1000 MWe. The results show that net plant efficiency of the MHD plant is significantly higher than a conventional steam plant of corresponding size. The cost of electricity is also less for the MHD plant over the entire plant size range. As expected, the cost differential is higher for the larger plant and decreases with plant size. Even at the 200 MWe capacity, however, the differential in COE between the MHD plant and the conventional plant is sufficient attractive to warrant serious consideration. Escalating fuel costs will enhance the competitive position of MHD plants because they can utilize the fuel more efficiently than conventional steam plants. S.L.

N83-26312# Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schifffahrt m.b.H., Geesthacht (West Germany). Zentralabteilung Technikum.

THE PELLWORM TEST FIELD FOR SMALL AND INTERMEDIATE WIND ENERGY CONVERSION SYSTEMS ON THE GERMAN COAST OF THE NORTH SEA

S. FRIES, G. PETERSEN, and H. T. MENGELKAMP 1982 25 p refs Presented at 4th Intern Symp. on Wind Energy Systems, Stockholm, 21-24 Sep. 1982; sponsored by BHRA Fluid Engineering (GKSS-82/E/39; ISSN-0344-9629) Avail: NTIS HC A02/MF A01

A test program involving 10 kW wind energy converters is described. The electrical power output of the converters as a function of the wind speed; annual energy production of the converters; investment costs per installed kW; and the cost of a produced kWh are calculated. Nine 10 m diameter machines are tested. The ac frequency and the rotor RPM are continuously calculated from the measured data by a microprocessor. The yaw angle for each horizontal axis machine is measured. Meteorological parameters are also recorded. Five of the converters are shown to be unsuited to the harsh climate of the test site.

Author (ESA)

N83-26316# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
OCEAN THERMAL ENERGY AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Apr. - Jun. 1982
 Jul. 1982 33 p refs
 (Contract DE-AI01-83ET-20342)
 (PB83-147306; JHU/APL/OQR/82-2) Avail: NTIS HC A03/MF A01 CSCL 10A

Ocean Thermal Energy Conversion (OTEC) systems that provide synthetic fuels (e.g., methanol), energy intensive products such as ammonia (for fertilizers and chemicals), and aluminum were developed. The work also includes assessment and design concepts for hybrid plants, such as geothermal OTEC (GEOTEC) plants. Management of the conceptual design activity of the two industry teams that are designing offshore OTEC pilot plants that could deliver power to Oahu, Hawaii is discussed. In addition, a program in which tests of a different kind of ocean energy device, a turbine that is air driven as a result of wave action in a chamber is being planned. GRA

N83-26371# Texas Univ., Austin. Dept. of Civil Engineering.
COASTAL-WIND ASSESSMENT: INTERVIEWS AND OBSERVATIONS
 N. K. WAGNER and C. E. MEYERS Aug. 1982 60 p refs
 (Contract DE-AC06-76RL-01830)
 (DE82-021376; PNL-3870) Avail: NTIS HC A04/MF A01

Delineation of wind characteristics in immediate section is discussed. Wind instruments were deployed in the study area, which includes Corpus Christi and Port Aransas, Texas, and the adjacent bays, inland waters, and the Gulf of Mexico. Interviews are summarized and compared with the data. The interview methodology, interviewing forms and techniques are described. The interview process has potential for use in the early phase of siting wind energy conversion systems. E.A.K.

N83-26645*# Bionetics Corp., Hampton, Va.
MEASUREMENTS AND OBSERVATIONS OF NOISE FROM A 4.2 MEGAWATT (WTS-4) WIND TURBINE GENERATOR
 K. P. SHEPHERD and H. H. HUBBARD (William and Mary Coll., Newport News, Va.) May 1983 33 p refs
 (Contract NAS1-16978; NAG1-166)
 (NASA-CR-166124; NAS 1.26:166124) Avail: NTIS HC A03/MF A01 CSCL 20A

Noise measurements and calculations are being made for large wind turbine generators to develop a data base for use in designing and siting such systems for community acceptance. As part of this program, measurements were made on the WTS-4 wind turbine generator during its acceptance runs. This paper presents the

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results of these exploratory measurements for power output conditions in the range 1.0 to 4.2 MW. Data include noise levels, spectra, radiation patterns, effects of distance, and the associated perception thresholds for use in the further development of acceptance criteria for this type of machine B W

N83-26762*# Mechanical Technology, Inc., Latham, N. Y.
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM
Quarterly Technical Report, 4 Oct. - 31 Dec. 1981
T. A. DERIKART, ed. Sep 1981 88 p refs
(Contract DEN3-32; EC-77-A-31-10040)
(NASA-CR-165263; DOE/NASA/0032-81/11; NAS 1 26 165263;
MTI-81ASE-185QT-11) Avail: NTIS HC A05/MF A01 CSCL
13F

The automotive Stirling engine development program is reviewed. Reference engine, component and subsystem development, engine testing, and computer models are summarized. Author

N83-26763*# Garrett Turbine Engine Co., Phoenix, Ariz.
ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM
DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS
Semiannual Progress Report, Jan. - Jun. 1982

Dec. 1982 76 p refs
(Contract DEN3-167)
(NASA-CR-168104; NAS 1.26:168104; GTEC-31-3725(5);
SAPR-5) Avail: NTIS HC A05/MF A01 CSCL 13F

Topics covered include the AGT 101 engine test, compressor design modification, cold air turbine testing; Mod 1 alloy turbine rotor fabrication, combustion aspects; regenerator development; and thermal screening tests for ceramic materials. The foil gas bearings, rotor dynamics, and AGT controls and accessories are also considered. A.R.H.

N83-26927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PLASMA POWERPLANT
S. YUYANG *In its* Aeronautical Knowledge (Selected Articles) (FTD-ID(RS)T-1228-82) p 3-8 17 Dec 1982 Transl. into ENGLISH from Hangkong Zhishi (China), no 3, Mar 1982
Avail: NTIS HC A02/MF A01 CSCL 21H

A plasma power plant consists of two main components: the plasma engine and the power unit. The former produces reactive thrust, and the latter supplies electrical energy. Plasma engines have the following characteristics: high specific impulse, low thrust, long operating time, can be started many times, low efficiency, and a thrust to weight ratio of less than 1. Plasma engines are divided into two major types according to the difference in functional principles: continuous and pulse. Author

N83-27166# Los Alamos Scientific Lab., N. Mex.
DESIGN AND DEVELOPMENT OF A TITANIUM HEAT-PIPE
SPACE RADIATOR
S. P. GIRRENS Mar 1982 29 p refs
(Contract W-7405-ENG-36)
(DE82-013749; LA-9251-MS) Avail: NTIS HC A03/MF A01

A titanium heat-pipe radiator was designed for use in a 100-kW/sub e/ nuclear-thermoelectric (TE) space power plant. The radiator is required to have a 99% probability of remaining functional at full power at the end of a seven-year mission. The radiator has a conical-cylindrical shape and is compatible for launch in the space shuttle. The radiator heat pipes are arranged into panel segments and each reactor-core thermoelectric heat-pipe unit has four radiator heat pipes for redundancy. Radiator mass was minimized based on acceptable losses due to micrometeoroid impact. Results of studies on various design parameters are presented in terms of radiator mass. Developments on the design and testing of the radiator heat pipes are also presented. Prototype titanium (potassium working fluid) heat pipes were fabricated and tested in space-simulating conditions. Testing results are compared to analytical performance predictions. DOE

N83-27200*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va
A NASA HIGH-POWER SPACE-BASED LASER RESEARCH AND APPLICATIONS PROGRAM
R. J. DEYOUNG, G. D. WALBERG, E. J. CONWAY, and L. W. JONES May 1983 46 p refs
(NASA-SP-464, NAS 1.21.464, LC-83-600161) Avail: NTIS HC
A03/MF A01 CSCL 20E

Applications of high power lasers are discussed which might fulfill the needs of NASA missions, and the technology characteristics of laser research programs are outlined. The status of the NASA programs or lasers, laser receivers, and laser propulsion is discussed, and recommendations are presented for a proposed expanded NASA program in these areas. Program elements that are critical are discussed in detail. S.L.

N83-27216# Welding Inst., Cambridge (England)
WELDING TECHNOLOGY FOR ENERGY CONVERSION
A. A. WELLS *In* ORNL Intern Conf. on Welding Technol for Energy Appl. p 1-16 Sep 1982 refs
Avail: NTIS HC A99/MF A01

Welding technology for pressure and storage vessels, piping, heat and mass transfer equipments, and dynamic parts for pumps, turbines and electric generators is reviewed. Particular emphasis is given to the present development and future prospects of the newer welding processes such as electron beam, friction and diffusion bonding, in comparison with the range of arc fusion processes, together with the joint properties that are obtained. Reference is also made to particular problems such as site construction, repair, remote welding, and heat treatment. M.G.

N83-27246# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.
HIGH-TEMPERATURE-TURBINE-TECHNOLOGY PROGRAM.
PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES.
DESIGN AND DEVELOPMENT OF A HIGH TEMPERATURE LOW
EMISSIONS COMBUSTOR FOR STATIONARY GAS TURBINES
Aug. 1982 136 p
(Contract DE-AC01-76ET-10348)
(DE83-005895; CW-WR-76-020.106A; FE-2291-106A) Avail
NTIS HC A07/MF A01

This report describes the design and test evaluation of a high temperature combustor component for an industrial gas turbine for a combined cycle power plant. Specific design considerations include operation at 26000 F to 30000 C combustor exit (turbine inlet) gas temperature with high combustion efficiency; operation on coal-derived or petroleum distillate fuel; staged combustion for control of emissions; and water-cooled combustor liners for long-term durability. A full size 10-in.-dia gas turbine combustor can utilizing the staged rich-lean burn concept was designed and tested up to an equivalent adiabatic 30000 F turbine inlet temperature with petroleum (JP4) and coal-derived middle distillate (SRC-II) liquid fuels. Fuel-air preparation and injection into the rich burn zone was accomplished by a single liquid fuel-air atomization and mixing tube utilizing a vaporizing reverse flow injection concepts. Combustion efficiencies of 98.7% and 99.4% were determined from measured emissions with each fuel (respectively) at a combustor exit temperature just under 30000 F. DOE

N83-27355# AiResearch Mfg Co., Torrance, Calif.
PHASE 2 BRAYTON/RANKINE 10-TON GAS-FIRED
SPACE-CONDITIONING SYSTEM Annual Technical Report
Jul 1982 105 p refs Sponsored in part by Gas Research Inst.
(Contract W-7405-ENG-26)
(DE82-016367; ORNL/SUB-80/24706/1; ATR-1) Avail: NTIS
HC A06/MF A01

The technical accomplishments to date in the design, development, and demonstration program leading to commercialization of a 10 ton heat actuated space conditioning system for light commercialization of a 10 ton heat actuated space conditioning system for light commercial building applications are summarized. The system consists of a natural gas powered Brayton

cycle engine and a Rankine cycle heat pump, combined in a single roof top package. The heat actuated space conditioning system provides more efficient use of natural gas and is intended as an all gas alternative to the electric heat pump. The system employs a subatmospheric natural gas fired heat pump. A centrifugal R-12 refrigerant compressor is driven directly from the Brayton engine rotating group through a hermetically sealed coupling. Unique features that offer high life cycle performance include a permanent magnet coupling, foil bearings, an atmospheric in-line combustor, and a high temperature recuperator DOE

N83-27372# Atlas Corp., Santa Cruz, Calif.
PROCEEDINGS OF THE SIXTH ANNUAL GEOTHERMAL CONFERENCE AND WORKSHOP

Dec. 1982 278 p refs Conf. held in Snowbird, Utah, 28 Jun - 1 Jul. 1982 Prepared by EPRI
 (Contract EPRI PROJ. WS-82-118)
 (DE83-901135; EPRI-AP-2760) Avail: NTIS HC A13/MF A01

Geothermal research projects, utility projects and plans are presented. A worldwide view of geothermal power development experience is included as well as accounts of discussions which focused on the theme of Shortening the Time to Power on Line

N83-27376# Biphase Energy Systems, Inc., Santa Monica, Calif.

WELLHEAD POWER PRODUCTION WITH A ROTARY SEPARATOR TURBINE (RP 1196)

D. J. CERINI and J. RECORD /in Atlas Corp. Proc. of the 6th Ann. Geothermal Conf and Workshop 7 p Dec. 1982 refs
 Avail: NTIS HC A13/MF A01

A rotary-separator turbine was built with full flow capacity for a 500 F downhole temperature with a 850,000 lbm/hr production rate. The test system and results obtained in field tests are described. The preliminary design of a 10-megawatt wellhead power plant for the Roosevelt type resource is described. This system shows a specific power of .0013 kW hr per lbm, which is 20 percent greater than an optimized wellhead single stage flash plant. This is 26 percent greater than a central plant of 20 to 50 MW capacity when consideration is given to steam-gathering system pressure drop between the wells and central plant S.L

N83-27387# City of Evanston, Ill.
DEMONSTRATION OF AN A-C UTILITY CONNECTED WIND GENERATOR IN A URBAN SETTING Final Report, Jun. 1979 - Dec. 1982

A. KISTLER, L. HILL, and H. BENJAMIN 31 Jan. 1983 99 p
 (Contract DE-FG02-79R5-10109)
 (DE83-006696; DOE/R5-10109/1) Avail: NTIS HC A05/MF A01

The goal of the work reported was the visible demonstration of an archetypical small wind machine specifically designed for urban conditions. A concurrent education program about wind machines and their urban potential was to be given for manufacturers, marketers, and consumers. The intent of the project, changes and developments are chronicled, followed by technical appendices and copies of educational and publicity materials.

DOE

N83-27394# Pacific Northwest Lab., Richland, Wash.
OPERATIONS REQUIREMENTS OF UTILITIES WITH WIND-POWER GENERATION

D. C. POWELL, S. M. CHAN, M. YOSHIMURA, and D. H. CURTICE Nov. 1982 11 p refs Presented at the IEEE Power Eng. Soc. Winter Meeting, New York, 31 Jan. 1983 Prepared in cooperation with Systems Control, Inc., Palo Alto, Calif.
 (Contract DE-AC06-76RL-01830)
 (DE83-007051; PNL-SA-10890; CONF-830107-3) Avail: NTIS HC A02/MF A01

A computational method and the necessary wind speed data are presented in this paper for quantifying in a probabilistic framework the load following, operating reserve and unloadable generation requirements for a utility with one or more spatially

dispersed wind turbine clusters. Results of this method are valid for random atmospheric conditions, excluding significant atmospheric events such as storm fronts. An example illustrating the proposed method is included. DOE

N83-27403# Shawinigan Engineering Corp., Montreal (Quebec)
INCREASED EFFICIENCY OF HYDROELECTRIC POWER Final Report

D. CREAMER and C. F. X. CADOU Jun. 1982 170 p Sponsored by EPRI
 (Contract EPRI PROJ 1745-1)
 (DE82-905771; EPRI-EM-2407) Avail: NTIS HC A08/MF A01

This report presents the results of a study into the potential for increasing the efficiency of hydroelectric generation at existing plants. The study did not include any direct examination of cost effectiveness Improvements in efficiency are defined as any cost effective changes which increase the net value of plant output. The study was confined to existing hydroelectric plants with an installed capacity of more than 10 MW, of which there are 518. Data were gathered from FERC and by a questionnaire to plant owners. Improvement of efficiency covered both physical plant improvement and improved operation of plants. Physical improvements dealt with in the study include the uprating of turbines and generators, leakage control and use of flashboards. Operational improvements relate to such matters as the optimum timing of operation and machine loading. The study dealt also with environmental (nonpower) constraints to plant efficiency.

DOE

N83-27443# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

RESEARCH RESULTS FOR THE TORNADO WIND-ENERGY SYSTEM: ANALYSIS AND CONCLUSIONS

E. JACOBS Jan. 1983 14 p refs Presented at the ASME Solar Energy Div. 6th Ann. Tech. Conf., Orlando, Fla., 19-21 Apr. 1983
 (Contract EG-77-C-01-4042; DE-AC02-77CH-00178)
 (DE83-006091; SERI/TP-211-1889) Avail: NTIS HC A02/MF A01

The Tornado Wind Energy System (TWES) concept utilizes a wind driven vortex confined by a hollow tower to create a low pressure core intended to serve as a turbine exhaust reservoir. The turbine inlet flow is provided by a separate ram air supply. Numerous experimental and analytical research efforts investigated the potential of the TWES as a wind energy conversion system (WECS). A simplified cost analysis incorporating research results is included. Based on these analyses, the TWES does not show significant promise of improving on either the performance or the cost of energy attainable by conventional WECS. The prospects for achieving either a system power coefficient above 0.20 or a cost of energy less than \$0.50 per/kWh (1979 dollars) appear to be poor.

DOE

N83-27461# Rockwell International Corp., Golden, Colo. Wind Energy Research Center.

TECHNICAL AND MANAGEMENT SUPPORT FOR THE DEVELOPMENT OF SMALL WIND SYSTEMS Annual Report for fiscal year, 1 Oct. 1980 - 30 Sep. 1981

Aug. 1982 130 p refs
 (Contract DE-AC04-76DP-03533)
 (DE83-007197; RFP-3425) Avail: NTIS HC A07/MF A01

Efforts of the Wind Systems Program are summarized, including program management, test operation, engineering, and project operations. DOE

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N83-27836*# Los Alamos Scientific Lab., N. Mex.
NUCLEAR REACTOR SYSTEM STUDY FOR NASA/JPL Final Report

R. G. PALMER, L. B. LUNDBERG, E. S. KEDDY, and D. R. KOENIG Sep. 1982 27 p refs Sponsored by NASA (NASA-CR-172631; NAS 1.26:172631; LA-9498-MS) Avail: NTIS HC A03/MF A01 CSCI 18K

Reactor shielding, safety studies, and heat pipe development work are described. Monte Carlo calculations of gamma and neutron shield configurations show that substantial weight penalties are incurred if exposure at 25 m to neutrons and gammas must be limited to 10 to the 12th power nvt and 10 to the 6th power rad, instead of the 10 to the 13th power nvt and 10 to the 7th power rad values used earlier. For a 1.6 MW sub t reactor, the required shield weight increases from 400 to 815 kg. Water immersion critically calculations were extended to study the effect of water in fuel void spaces as well as in the core heat pipes. These show that the insertion into the core of eight blades of B4C with a mass totaling 2.5 kg will guarantee subcriticality. The design, fabrication procedure, and testing of a 4m long molybdenum/lithium heat pipe are described. It appears that an excess of oxygen in the wick prevented the attainment of expected performance capability. S.L.

N83-27837# Los Alamos Scientific Lab., N. Mex.
SPACE REACTORS Progress Report, Jul. - Sep. 1981

W. A. RANKEN Jun. 1982 40 p (Contract W-7405-ENG-36) (DE82-019187, LA-9479-PR) Avail: NTIS HC A03/MF A01

Progress in technology development for the Space Power Advanced Reactor (SPAR) project is reported. The weights of neutron and gamma shields required to protect the SPAR system payloads for a range of permissible exposures was determined, and initial results are reported. SPAR reactor safety in the case of water immersion was modeled. Approval in principle was received for the SPAR fuel test in the Experimental Breeder Reactor; the heat pipe developed for this test is performing well. SPAR system design variations are being examined under the possibility of using long core heat pipes. Testing of the initial molybdenum/sodium artery heat pipe continued, with ambiguous results. Fabrication of the first all bonded thermoelectric units was completed and testing was initiated. DOE

N83-27861# Los Alamos Scientific Lab., N. Mex.
HIGH-POWER-DENSITY APPROACHES TO MAGNETIC FUSION ENERGY: PROBLEMS AND PROMISE OF COMPACT REVERSED-FIELD PINCH REACTORS (CRFPR)

R. L. HAGENSON (Technology International, Inc), R. A. KRAKOWSKI, and H. DREICER 1982 25 p refs Presented at the Conf. on New Trends in Unconventional Approaches to Magnetic Fusion, Stockholm, 16-18 Jun. 1982 (Contract W-7405-ENG-36) (DE82-015736, LA-UR-82-1480; CONF-820644-2) Avail: NTIS HC A02/MF A01

If the cost assumptions upon which the positive assessment of conventional large superconducting fusion reactors are based proves optimistic, approaches that promise considerably increased system power density and reduced mass utilization are required. These more compact reactor embodiments generally must operate with reduced shield thickness and resistive magnets. Because of the unique magnetic topology associated with the Reversed Field Pinch (RFP), the compact reactor embodiment of this approach is particularly attractive from the view point of low field resistive coils operating with Ohmic losses that are small relative to the fusion power. The RFP, one example of a high power density (HPD) approach to magnetic fusion energy. A comprehensive system model is described and applied to select a unique, cost optimized design point that is used for a subsequent conceptual engineering design of the Compact RFP Reactor. DOE

N83-27873# National Science Foundation, Washington D.C.
END-USE PRODUCTS OF FUSION ENERGY: ALTERNATIVES AND THEIR IMPLICATIONS TO THE FUSION ENERGY R AND D STRATEGY

1982 141 p refs Workshop held at Washington, D.C., 4-5 Mar 1982 (PB83-151696; NSF/PRA-82028) Avail: NTIS HC A07/MF A01 CSCI 18A

The objectives of the current magnetic fusion program were outlined and the efforts of the Department of Energy to find uses for the products of fusion energy were summarized. Various applications of the high-temperature electrolysis process and the sulfur iodine process in both Tokamak and tandem mirror-type reactors were included. Synthetic fuel production and its role in fusion were addressed. It was suggested that a fusion reactor will never be economically competitive with a fission reactor and that a hybrid may be a viable alternative to a pure fission reactor. Reasons for pursuing the fusion breeder were offered and work on fusion hybrids was reviewed. GRA

N83-27874# National Academy of Sciences - National Research Council, Arlington, Va Committee on Magnetic Fusion
FUTURE ENGINEERING NEEDS OF MAGNETIC FUSION Final Report, 15 Feb. - 30 Nov. 1982

30 Nov 1982 111 p refs (Contract DE-FG01-82ER-54008) (PB83-149757) Avail: NTIS HC A06/MF A01

A workshop examined engineering needs, how well they can be defined and how the engineering capacity of industry might be engaged more effectively in the magnetic fusion program. The workshop assessed prior conceptual design studies for fusion reactor systems such as tokamaks and magnetic mirror machines, the principal plasma and nuclear subsystem, integration of the subsystems into a whole, future modes of industrial participation, and a sampling of views from the larger engineering community. It was concluded, in particular, that conceptual design studies were valuable. Also, engineering needs for impurity control in the plasma and for reactor materials are in most need of better understanding. Furthermore, actual developments put forward to satisfy most of the perceived engineering needs require proving in the rigorous environment of a reactor-prototypical plasma. The overall conclusion was that the engineering needs of magnetic fusion can be identified with a relatively high level of confidence, within the boundaries of the accumulated scientific evidence and the adopted design objectives, and that development programs have been initiated to address many of these needs. GRA

N83-27927# R and D Associates, Marina Del Rey, Calif.
CONCEPT EVALUATION OF AUTOMOTIVE PROPULSION USING LIQUID AIR/NITROGEN Final Report

J L DOOLEY and R. P. HAMMOND 1982 156 p refs (Contract DE-AC01-81ER-30011) (DE82-016992; RDA-TR-18700-003) Avail: NTIS HC A08/MF A01

A technical and economic assessment is made of an automotive powerplant system using cryogenic liquid air or nitrogen as the working fluid. In an open Rankine cycle the cold fluid is stored at atmospheric pressure; as needed for use, small quantities are pressurized and heated to high temperature before expanding in a multistage engine that drives the vehicle. A range of gas pressures and temperatures and different expansion stages and reheat variations were evaluated to give a complete thermodynamic profile of the system. One possible design of each component in the power train is shown, and the sizes, weights and probable manufacturing cost estimated. Installation of these components in a passenger vehicle of conventional size is shown to be feasible. The assessment shows that a liquid nitrogen powered vehicle could be generally competitive with current gasoline automobiles in performance, weight, range and operating cost without using imported fuel and without harmful emissions. DOE

N83-28075# Oak Ridge National Lab., Tenn
TECHNOLOGICAL LIMITATIONS ON NUCLEAR-ELECTRIC SPACE-POWER SYSTEMS

A. P. FRAAS 1982 11 p refs Presented at the Conf. on Prime Power for High-energy Space Systems. Norfolk, Va., 22-25 Feb 1982

(Contract W-7405-ENG-26)

(DE82-011511; CONF-820228-1) Avail: NTIS HC A02/MF A01

Different types of space power reactors are compared. Information is presented concerning the choice of fluid circuit structural materials; fuel elements, comparison of one loop, two loop, and three loop systems; reliability of mechanical components; reliability of control systems; zero-g problems; and hazards problems. DOE

N83-28319* National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville, Ala

ELECTRICAL POWER GENERATING SYSTEM Patent

F. J. NOLA, inventor (to NASA) 14 Jun. 1983 4 p Filed 16 Mar 1981

(NASA-CASE-MFS-25302-1; US-PATENT-4,388,585, US-PATENT-APPL-SN-243683; US-PATENT-CLASS-322-47, US-PATENT-CLASS-322-29; US-PATENT-CLASS-322-35, US-PATENT-CLASS-322-95) Avail US Patent and Trademark Office CSCL 09C

A power generating system for adjusting coupling an induction motor, as a generator, to an AC power line wherein the motor and power line are connected through a triac is described. The triac is regulated to normally turn on at a relatively late point in each half cycle of its operation, whereby at less than operating speed, and thus when the induction motor functions as a motor rather than as a generator, power consumption from the line is substantially reduced.

Official Gazette of the U S Patent and Trademark Office

N83-28458# General Power Corp., Paoli, Pa.
DOE WAVE-TURBINE-ENGINE DEMONSTRATION Final Report

R. R. COLEMAN 11 Jun 1982 24 p refs

(Contract DE-FG05-79ER-10063)

(DE82-018322; DOE/ER-10063/T1) Avail: NTIS HC A02/MF A01

Research on a wave turbine engine, a device which uses energy of vehicle engine exhaust gases to compress the engine inlet air, and which can perform the same function as a conventional turbocharger, is described. A wave turbine engine was designed, built and tested with results that clearly demonstrate: effective wave compression and expansion; and a proportional relationship between fuel flow and shaft horsepower at low speed, under 11,000 rpm. This relationship shows increasing overall efficiency with increased power. This project had demonstrated the potential of the wave engine for a wide range of applications. Significant progress was made to show that this technology is a practical basis for advanced power units with definite advantages over high performance conventional units. DOE

N83-28460# Volkswagen A.G., Wolfsburg (West Germany).
 Forschung und Entwicklung

MATERIAL RESEARCH, MATERIAL DEVELOPMENT AND PROCEDURE DEVELOPMENT FOR CERAMIC GAS TURBINE PARTS Final Report [WERKSTOFFUNTERSUCHUNGEN, WERKSTOFFENTWICKLUNG UND VERFAHRESENTWICKLUNG FUER KERAMISCHE GASTURBINENBAUTEILE]

SIEBELS 19 Aug. 1981 76 p refs In GERMAN

(Contract BMFT-NTS-1006)

(FZL-8110-V/5) Avail: NTIS HC A05/MF A01

Long term stability of silicon nitride and silicon carbide materials, high temperature resistance, ceramic-ceramic and ceramic-metal bonding, and high temperature soldering procedures are described for automobile gas turbine engine applications. Test results show that the use of ceramic materials for static parts is more promising than for rotors. Bonding materials are often deficient.

Author (ESA)

N83-28584# Westinghouse Electric Corp., Pittsburgh, Pa. Energy Conversion Branch.

US AIR FORCE FUEL CELL APPLICATION ANALYSIS Final Report, 1 Sep. 1980 - 1 Jan. 1982

W. D. POUCHOT, W. A. SUMMERS, and J. A. HOFBAUER Wright Patterson AFB, Ohio AFWAL Jan 1982 450 p refs

(Contract F33615-80-C-2038, AF PROJ 3145)

(AD-A126121; WAESD-TIME-3134, AFWAL-TR-82-2004) Avail NTIS HC A19/MF A01 CSCL 10B

Fuel Cell Power Unit conceptual designs and cost/benefit analyses were accomplished for six US Air Force applications. The applications included two attended remote sites, two unattended remote sites and two tactical/mobile requirements. The electrical power ratings of these designs ranged from 23 kW to 100 kW. Fuels considered included diesel, Jet Fuel (JP-4) and methanol. Life cycle cost and benefit analyses showed that significant savings and operational improvements could be realized with the introduction of fuel cells into the USAF power generation inventory. Author (GRA)

N83-28638# Little (Arthur D.), Inc., Cambridge, Mass.

WIND-TURBINE PERFORMANCE ASSESSMENT

W. A. VACHON Jan 1983 128 p refs

(Contract EPRI PROJ. 1996-1)

(DE83-901449, EPRI-AP-2796, TSR-5) Avail: NTIS HC A07/MF A01

Test data and experiences from funded wind turbine (WT) development and test programs in the United States and Europe are summarized. Summaries of test results for the US Department of Energy (DOE) cluster of three COD-2 2.5-MW/WT's, four MOD-OA 0.2-MW WT's, and three 0.1-MW vertical-axis WT's are presented. Descriptions of the DOE's two MOD-5 WT's, with power ratings of 7.3 and 7.2 MW, are also provided. The US Department of the Interior's Bureau of Reclamation program is updated with status reports on the 4-MW and 2.5-MW system verification units and recent test results from privately funded programs are summarized. A summary of key foreign WT programs, including test results from ongoing Danish machine tests are discussed. DOE

N83-28645# Illinois Inst. of Tech., Chicago Dept. of Mechanical Engineering

THERMAL-ECONOMIC ANALYSIS OF ORGANIC RANKINE COMBINED CYCLE COGENERATION

R. W. PORTER Dec 1982 99 p refs

(Contract DE-FG02-80CS-40337)

(DE83-007143; DOE/CS-40337/13; IIT-TR-82-3) Avail: NTIS HC A05/MF A01

An evaluation of organic rankine cycles (ORC) as combined with topping incorporating gas turbines or diesel engines, and with subsequent waste heat utilization is presented. It is found that the potential benefit of the proposed organic Rankine combined cycle cogeneration of useful heat and electricity is more flexible in meeting demands for the two products, by varying the mode of operation of the system. A thermal-economic analysis is developed and illustrated with cost and performance data for commercially available equipment, and with general economic parameters reflecting current regulations and market conditions. The performance of the ORC and of the entire combined cycle is described. Equations to evaluate the various thermodynamic and economic parameter, and the resultant case flows are presented. Criteria are developed to assess the addition of an ORC to a cogeneration system without ORC is viable based on rate of return on incremental investment. It is indicated that the proposed system is potentially viable, however, it is not viable under conditions prevailing in Chicago for the selected case studies. DOE

05. ENERGY CONVERSION

N83-28669# Stanford Univ, Calif. Lab. for High Temperature Gasdynamics.

ACOUSTIC AND ENTROPY WAVES IN A COMBUSTION MHD GENERATOR Ph.D. Thesis

T. D. SIMONS Jun. 1982 192 p refs

(Contract DE-AC01-80ET-15611, EX-76-C-01-2341)

(DE82-017155, DOE/ET-15611/T5; HTGL-203) Avail. NTIS HC A09/MF A01

Simultaneous, sensitive, high frequency measurements of pressure and temperature fluctuations associated with traveling acoustic and entropy pulses were made in a combustion MHD generator under conditions of applied magnetic field (up to 2.2 Tesla) and moderate current density (up to 1.0 amp per square centimeter). The experimental observations and a closed form analytical description of the magneto-acoustic interaction suggest that nonideal phenomena, including near electrode phenomena, heat transfer, and possible secondary flows can substantially inhibit wave growth or attenuation caused by magneto-acoustic instabilities. Disturbances in the plasma temperature and pressure were created by the rapid discharge of a capacitor into the moving conducting plasma. Inside the generator, transient measurements were taken at three locations using a probe-tube microphone for pressure measurements, a fiber-optic luminosity probe for relative temperature measurements, and transverse mounted voltage pins to measure local voltage profiles. DOE

N83-28670# Westinghouse Electric Corp., Pittsburgh, Pa. Chemical Engineering Dept.

ASSESSMENT OF DEPOSITION FOR POWER-PLANT MOLTEN-CARBONATE FUEL CELLS

R. A. WENGLARZ 15 Mar. 1982 28 p refs

(Contract DE-AM06-77RL-00600)

(DE82-013398; DOE/RL-00600/T2; REPT-82-9E3-EGGCP-P2)

Avail. NTIS HC A03/MF A01

Particulate deposition in molten carbonate fuel cell anodes is addressed for operation with future coal gasification power plants. Power plant systems factors affecting deposition are explored such as gas cleanup requirements for particulate removal and gasifier product gas composition differences for various gasifier types and operational modes (air blown versus oxygen blown). Effects of fuel cell characteristics (including average cell current density and fuel utilization) on anode deposition are also quantified. Particulate effects on molten carbonate fuel cell anode performance may not be as detrimental as perhaps perceived in the past. Gas cleanup to remove virtually all particles larger than one micron in diameter is expected to prevent or at least greatly reduce anode deposition. However, cathode deposition in molten carbonate fuel cells should be evaluated in the future since cathodes are likely more prone to deposition than anodes even though cathode channel particle concentrations are much lower. DOE

N83-28672# Ebasco Services, Inc., New York

TECHNOLOGY ASSESSMENT: MUNICIPAL SOLID WASTE AS A UTILITY FUEL Final Report

M. I. NEPARSTEK and G. A. CYMNY May 1982 295 p

Sponsored by EPRI

(Contract EPRI PROJ. 1255-3)

(DE82-905355; EPRI-CS-2409) Avail. NTIS HC A13/MF A01

This study updates a 1974 EPRI technology assessment of municipal solid waste (MSW) as a utility fuel. An independent and consistent assessment of the development status and conceptual design and economics is presented for the following refuse-to-electricity technologies; mass burning of MSW in a dedicated boiler; preparation of coarse RDF and firing in a dedicated boiler; preparation of wet RDF and firing in a dedicated boiler; preparation of fluff RDF and cofiring with coal in a utility boiler; and preparation of dust RDF and cofiring with coal in a utility boiler. The generated steam is used to drive a turbine-generator and produce electricity. Utility ownership and financing are assumed for the coal-fired power plant used for RDF cofiring and the turbine generators driven by refuse-generated steam. Municipal ownership is assumed for the RDF preparation

facilities and the MSW mass burning and RDF-fired dedicated boilers. DOE

N83-28711# Hawaii Univ., Manoa Natural Energy Inst.

WIND-ENERGY BATTERY-STORAGE PROJECT, PHASE 1 Final Report

D. R. NEILL and G. D. CURTIS Jan 1983 100 p refs

(Contract DE-AC04-76DP-00789)

(DE83-009389; SAND-82-7211) Avail. NTIS HC A05/MF A01

A program which involves data collection, development of a computer model, and use of the data in the model to simulate use of the WEBS in a specific locality is described. The data collection involved hourly wind samples, load data, and performance and cost information on candidate equipment. The model enables the user to call these data from files, configures the systems, and obtain performance measures and operational statistics. Comparative economic analyses on probable configurations indicate that an array of wind machines can be cost effective but that battery storage is economically marginal unless it can interact usefully with the utility. Batteries do, however, contribute to better system operation. DOE

N83-28713# Institute of Gas Technology, Chicago, Ill.

ELECTROLYTE VAPORIZATION LOSSES FROM MOLTEN-CARBONATE FUEL CELLS

E. T. ONG and T. D. CLAAR 1982 28 p refs Presented at the Spring Meeting of the Electrochem Soc., Montreal, 9-14 May 1982

(Contract DE-AC02-78ET-11276; DE-AC02-80ET-17019)

(DE83-009382, CONF-820508-7) Avail. NTIS HC A03/MF A01

Electrolyte loss by vaporizing was identified as a significant performance degradation mechanism in molten carbonate fuel cells. The continuous nature of electrolyte vaporization leads to development of tile porosity, which results in increased cell resistance, gas crossover, and loss of structural integrity. Electrolyte losses from fuel are reviewed and out of cell measurements of vapor loss from carbonate melts performed at IGT are presented. These out of cell vapor losses are compared with vaporization losses determined from fuel cells operated for 10,000 hours. DOE

N83-28725# California Univ., Berkeley. Lawrence Berkeley Lab.

ENGINEERING ANALYSIS OF AN NH3-AIR ALKALINE FUEL CELL SYSTEM FOR VEHICULAR APPLICATIONS

P. N. ROSS, JR. Jun. 1982 25 p refs Presented at Workshop on Renewable Fuels and Advan. Power Sources for Transport, Denver, 17 Jun. 1982

(Contract DE82-018517)

(DE82-018517; LBL-14578; CONF-820686) Avail. NTIS HC A02/MF A01

The use of a hydrogen air alkaline fuel cell in a vehicle with liquid anhydrous ammonia as the hydrogen storage medium was examined. In the system analyzed here, hydrogen is supplied to the fuel cell by the catalytic cracking of liquid anhydrous ammonia, making the total system an indirect NH3 air fuel cell system. It was found that the endothermicity of the NH3 cracking reaction is supplied by combustion of the anode vent gas after utilizing 80% of the hydrogen electrochemically resulting in a minimal efficiency penalty. Laboratory scale examinations were made of the ammonia cracking reaction and the power characteristics of an alkaline fuel cell running on cracked ammonia and air. Single cell and bicell testing indicated system thermal efficiencies of 48 to 60% (based on L.H.V. of NH3) can be achieved at power densities of 1 to 2.6 kW/sq m using currently known electrode technology in a bipolar design. DOE

N83-28734# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

RAFT RIVER 5MW POWER PLANT: A SMALL BINARY POWER PLANT

J. F. WHITBECK, E. G. DIBELLO, and L. F. WALRATH 1982 11 p Presented at the Geothermal Resources Council Meeting, Long Beach, Calif., 13 Jun. 1982

(Contract DE-AC07-76ID-01570)

(DE82-018992; EGG-M-12482; CONF-820690-1) Avail: NTIS HC A02/MF A01

The Raft River 5MW power plant is a binary cycle pilot plant. The system uses isobutane in a dual boiling cycle. This cycle was selected because the well field and temperatures were not well known at the time of cycle selection, and therefore, a boiling cycle was desirable. The dual boiling features provides about 15 to 20% more power and makes the output less sensitive to changes in geothermal temperature changes than a single boiler system. The plant design was based upon a 290F geothermal fluid temperature at the inlet to the plant and has a gross nominal generator rating of 5MW; however, actual output will vary according to ambient wet bulb temperatures over a range from 4.4MW to 6.2MW with the actual plant inlet temperature of 278F being obtained. The plant is supplied by three production wells. Geothermal fluid boost pumps within the plant inlet provide the pressure necessary to overcome plant pressure drop and return the fluid to the two injection sites. DOE

N83-28740# Argonne National Lab., Ill.

SOLAR LIQUID-METAL MHD PERFORMANCE PREDICTIONS

H. K. GEYER and E. S. PIERSON 1982 6 p refs Presented at the 20th Symp. on the Eng. Aspects of MHD, Irvine, Calif., 14 Aug. 1982

(Contract W-31-109-ENG-38)

(DE83-007865; CONF-8208116-1) Avail: NTIS HC A02/MF A01

Previous liquid-metal MHD (LMMHD) solar studies demonstrated attractive performance based on component parameters characteristic of mature systems. Near term applications, i.e., conservative component parameters and lower temperatures were studied. Efficiencies are calculated for LMMHD Rankine cycles at 420 to 470 K, and LMMHD Brayton cycles at 700 to 810 K. It appears that efficiencies are competitive with alternative energy conversion concepts. DOE

N83-28749# Texas A&M Univ., College Station. Dept. of Chemical Engineering.

METAL CHELATE CATALYSTS FOR FUEL CELLS Final Report, Jun. 1979 - Oct. 1982

R. DARBY, M. YAMANA, H. DHAR, and R. WHITE Oct. 1982 84 p refs Sponsored by Gas Research Inst.

(PB83-167270; GRI-82/0027) Avail: NTIS HC A05/MF A01 CSCL 10B

Various modified forms of several organometallic chelate compounds were synthesized and tested for their activity and stability as oxygen reduction electrocatalysts in sulfuric acid electrolyte. The most active catalysts found were cobalt tetraazaannulene (CoTAA), iron phthalocyanine (FePc) and cobalt tetraphenylporphyrin (CoTPP). However, these catalysts have limited stability in strong acids. Author (GRA)

N83-29027# Los Alamos Scientific Lab., N. Mex.

DESIGN OPTIONS FOR THE SP-100 THERMOELECTRIC NUCLEAR SPACE POWER PLANT

D. R. KOENIG and W. A. RANKEN 1982 7 p refs Presented at 17th Intersoc. Energy Conversion Engr. Conf., Los Angeles, 8 Aug. 1982

(Contract W-7405-ENG-36)

(DE82-015813; LA-UR-82-1360; CONF-820814-9) Avail: NTIS HC A02/MF A01

Design options for the SP-100 Space Nuclear Power Plant (formerly SPAR) are reviewed that led to the current, radiatively coupled, baseline system design described in this paper. The selection of the radiative coupled configuration provides features that facilitate assembly, improves reliability and reduces the

interactions between the nuclear and converter subsystem designs. Also the core design has continued to evolve incorporating individual fuel modules in the design. DOE

N83-29061# Stanford Univ., Calif.

HIGH-MAGNETIC-FIELD MHD-GENERATOR PROGRAM Quarterly Report, 1 Jan. 1982 - 30 Mar. 1982

C. H. KRUGER, R. H. EUSTIS, M. MITCHNER, S. A. SELF, J. K. KOESTER, and T. NAKAMURA Apr. 1982 24 p refs

(Contract DE-AC01-80ET-15611)

(DE82-015447; DOE/ET-15611/9) Avail: NTIS HC A02/MF A01

Progress in an experimental and theoretical program designed to investigate a number of important problems in the development of MHD generator channels is summarized. The areas of research include nonuniformity and stability effects, boundary layers, Hall field breakdown, the effects of electrode configuration and current concentrations, and studies of steady-state combustion disk and linear channels in a 6-Tesla magnet of small dimensions. DOE

N83-29063# Burns and Roe, Inc., Woodbury, N. Y.

UTILITY REQUIREMENTS FOR FUSION

R. J. VONDRASEK Feb. 1982 141 p Sponsored by EPRI

(Contract EPRI PROJ. 1413-1)

(DE82-903118; EPRI-AP-2254) Avail: NTIS HC A07/MF A01

Work done and results obtained during performance of Task 1 of a study of Utility Requirements and Criteria for Fusion Options are described. The work consisted of developing a list of utility requirements for fusion optics containing definition of the requirements and showing their relative importance to the utility industry. The project team members developed a preliminary list which was refined by discussions and literature searches. The refined list was recast as a questionnaire which was sent to a substantial portion of the utility industry in this country. Forty-three questionnaire recipients responded including thirty-two utilities. A workshop was held to develop a revised requirements list using the survey responses as a major input. The list prepared by the workshop was further refined by a panel consisting of vice presidents of the three project team firms. The results of the study indicate that in addition to considering the cost of energy for a power plant, utilities consider twenty-three other requirements. Four of the requirements were judged to be vital to plant acceptability: Plant Capital Cost, Financial Liability, Plant Safety and Licensability. DOE

N83-29075# Princeton Univ., N. J. Plasma Physics Lab.

ROLE OF ATOMIC COLLISIONS IN FUSION

D. E. POST Apr. 1982 63 p refs

(Contract DE-AC02-76CH-03073)

(DE82-014961; PPPL-1877) Avail: NTIS HC A04/MF A01

Atomic physics issues have played a large role in controlled fusion research. A general discussion of the present role of atomic processes in both magnetic and inertial controlled fusion work is presented. DOE

N83-29239# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GAS TURBINES FOR THE PRODUCTION OF ELECTRICAL AND THERMAL ENERGY

V. POTOCNIK 28 Jan. 1983 30 p refs Transl. into ENGLISH from Energija (Yugoslavia), no. 11-2, 1973 p 375-384

(AD-A126182; FTD-ID(RS)T-1611-82) Avail: NTIS HC A03/MF A01 CSCL 21E

Basic types of gas turbines are described. A review is presented of the application of gas turbines to the production of electrical and thermal energy. Trends in potential development are discussed. R.J.F.

N83-29407# Volkswagen A.G., Wolfsburg (West Germany). Forschung Antriebstechnik.

DEVELOPMENT OF CERAMIC AUTOMOBILE TURBINE ENGINE COMPONENTS Final Report, Apr. 1981

M. LANGER and J. SIEBELS Bonn Bundesministerium fuer Forschung und Technologie Mar. 1983 126 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-83-025; ISSN-0340-7608) Avail. NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 26,50

The development of ceramic components for an experimental gas turbine of 100 kW output is discussed. Satisfactory application of statically loaded ceramic parts, e.g., hot testing of a turbine stator ring, is described. Monolithic axial turbine rotors made from reaction bonded silicon nitride (RBSN) were cold tested successfully up to circumferential speeds in excess of 400 m/sec. Results for monolithic sintered silicon carbide radial turbine rotors under normal operating conditions are good. Individual RBSN turbine blades mounted in metal disks satisfy qualification tests.

Author (ESA)

N83-29408# Rosenthal-Stemag, Technische Keramik A.G., Selb (West Germany).

DEVELOPMENT OF HIGH-TEMPERATURE RESISTANT, NONCORROSIBLE, NONMETALLIC CERAMIC MATERIALS, ESPECIALLY SILICON NITRIDE, FOR HEAT EXCHANGERS IN GAS TURBINE APPLICATION Final Report, Feb. 1980

S. SCHINDLER and A. KRAUTH Bonn Bundesministerium fuer Forschung und Technologie Mar. 1983 106 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-83-026; ISSN-0340-7608) Avail. NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22

The improvement of silicon nitride concerning oxidation resistance and strength, suitable production techniques such as foil casting, injection molding, extrusion and isostatic pressing, as well as the manufacturing of structural components with improved material data (heat exchanger, single stator blades and 4-blade-segments) for test purposes are examined. A close relationship between production techniques, construction and testing in simulated application conditions is found. In spite of the change of production technique - from extrusion to foil casting - the progress in heat exchanger development is promising.

Author (ESA)

N83-29803 Netherlands Organization for Applied Scientific Research TNO, Delft. Hoofdgroep Maatschappelijke Technologie.

PRELIMINARY INVESTIGATION OF THE CHARACTERISTICS OF AN OSCILLATING WINDPOWERED GENERATOR [ORIENTEREND ONDERZOEK NAAR DE EIGENSCHAPPEN VAN EEN VLAAGGENERATOR]

P. E. J. VERMEULEN Dec 1981 43 p refs In DUTCH Original contains color illustrations (TNO-82-0344) Avail. Issuing Activity

The requirements for active turbulence generating systems are discussed and measurements with an oscillating vane generator are described. The excitation of lateral velocity fluctuations was investigated. The oscillating vane concept allows these fluctuations to be adjusted within a limited domain directly by the incident angle variations of the generator blades. This enables a turbulence structure in the frequency, amplitude, and time domains to be obtained. The lateral fluctuations are accompanied by small longitudinal fluctuations which are limited by keeping the profile resistance as low as possible. Measurements were performed with an oscillating vane system generating longitudinal velocity fluctuations, which are much determined by the blades incident angle. Contrary to the lateral fluctuations case, the domain for behind generator can be used, enabling the longitudinal fluctuation generator to be put at a certain distance in front of the lateral fluctuation generator in a combined turbulence generating system.

Author (ESA)

N83-29804*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

HIGH THERMAL POWER DENSITY HEAT TRANSFER APPARATUS PROVIDING ELECTRICAL ISOLATION AT HIGH TEMPERATURE USING HEAT PIPES Patent Application

J. F. MORRIS, inventor (to NASA) 24 Jun 1983 10 p (NASA-CASE-LEW-12950-2, US-PATENT-APPL-SN-507626) Avail: NTIS HC A02/MF A01 CSCI 10A

This invention is directed to transferring heat from an extremely high temperature source to an electrically isolated lower temperature receiver. The invention is particularly concerned with supplying thermal power to a thermionic converter from a nuclear reactor with electric isolation. Heat from a high temperature heat pipe is transferred through a vacuum or a gap filled with electrically nonconducting gas to a cooler heat pipe. The heat pipe is used to cool the nuclear reactor while the heat pipe is connected thermally and electrically to a thermionic converter. If the receiver requires greater thermal power density, geometries are used with larger heat pipe areas for transmitting and receiving energy than the area for conducting the heat to the thermionic converter. In this way the heat pipe capability for increasing thermal power densities compensates for the comparatively low thermal power densities through the electrically nonconducting gap between the two heat pipes.

NASA

N83-29810*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA REDOX PROJECT STATUS SUMMARY

N. H. HAGEDORN Apr 1983 13 p Presented at the 5th Battery and Electrochem. Contractors' Conf., Arlington, Va., 7-9 Dec. 1982; sponsored by DOE (Contract DE-AI04-80AL-12726) (NASA-TM-83401; E-1679, DOE/NASA/12726-22, NAS 1.15.83401) Avail. NTIS HC A02/MF A01 CSCI 10C

This report is a summary of the results of the Redox Project effort during Cy 1982. It was presented at the Fifth U.S. Department of Energy Battery and Electrochemical Contractors Conference, Arlington, Va., Dec. 7-9, 1982. The major development during 1982 was the shift from Redox system operation at 25 C with unmixed reactants to operation at 65 C with mixed reactants. This change has made possible a two- or three-fold increase in operating current density, to about 65 mA/sq cm, and an increase in reactant utilization from 40% to about 90%. Both of these improvements will lead to significant system cost reductions. Contract studies have indicated that Redox reactant costs also will be moderate. A new catalyst for the chromium electrode offers all the advantages of the conventional gold-lead catalyst while being easier to apply and more forgiving in use.

Author

N83-29814# Aerojet Energy Conversion Co., Sacramento, Calif. HYDRODYNAMIC/KINETIC REACTIONS IN LIQUID-DOMINATED GEOTHERMAL SYSTEMS Final Report, Apr. 1979 - Apr. 1981

J. P. NESEWICH and C. M. GRACEY Apr. 1982 233 p refs (Contract W-7405-ENG-36) (DE82-017287, DOE/NBM-2017287) Avail: NTIS HC A11/MF A01

A mobile geothermal well-site test unit at the Mercer 2 well in South Brawley, California (Imperial Valley), was constructed and tested. The equipment controlled, monitored, and recorded all process conditions of single- and dual-flash power cycles. Single and two-phase flashed brine effluents were flowed through piping component test sections to provide hydrodynamic/kinetic data for scale formation. The unit operated at flowrates in excess of 200 gpm and is designed to accommodate flowrates up to 300 gpm. Primary scale formations encountered were those of PbS, Fe₂(OH)₃Cl (iron hydroxychloride), iron chlorides, and non-crystalline forms of SiO₂. The formation of iron hydroxychloride was due to the unusually high concentration of iron in the wellhead brine (5000 mg/l).

DOE

N83-29819# Los Alamos Scientific Lab., N. Mex.
ELECTROCHEMISTRY OF FUEL CELLS FOR TRANSPORTATION APPLICATIONS

E. R. GONZALEZ and S. SRINIVASAN 1982 7 p refs
 Presented at the World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982

(Contract W-7405-ENG-36)

(DE82-008115; LA-UR-82-417; CONF-820605-9) Avail: NTIS HC A02/MF A01

Fuel cells are the most promising power sources for electric vehicles and do not suffer the inherent limitations of efficiency, energy density, and lifetime, and encountered with all types of batteries considered for this application. The projected performance of fuel-cell-powered vehicles is comparable to that of the internal combustion and diesel engine vehicles but with the additional advantages of higher fuel efficiency, particularly with synfuels from coal. The ideal fuel for a fuel cell power plant for electric vehicles is methanol. This fuel is reformed to hydrogen, which combines with oxygen from the air in an acid electrolyte (phosphoric, solid polymer, or superacid) fuel cell to produce electricity. Though the phosphoric acid fuel cell is in the most advanced state of development (mainly for power generation applications), the solid polymer and superacid electrolyte fuel cells are more promising for the transportation application because of the faster oxygen reduction kinetics (and hence potential for higher power densities) and shorter start-up times. DOE

N83-29847# Argonne National Lab., Ill.
OTEC PLANTS FOR TODAY'S ISLAND MARKET

R. NIEMANN, F. DAVIS, L. GENENS, D. HILLIS, C. PANCHAL, N. SATHER, H. STEVENS, and A. THOMAS 1982 7 p refs
 Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8 Aug 1982. Previously announced as A83-27227 (Contract W-31-109-ENG-38)

(DE83-008670; CONF-820814-41) Avail: NTIS HC A02/MF A01

Design features of a proposed commercial 10 MWe OTEC power plant are presented. The plans rely on existing technology, with shore basing in Hawaii, NH₃ in the coolant loop, a closed cycle, and a design life of 30 yr. Shell and the evaporators are adopted, together with periodic chlorination to prevent biofouling, and grid interconnect. Built with two 5 MWe modules, the OTEC system has hot and cold water pipes interfaced below sea level to wells, with one sea water pump for each heat exchanger. Ti tubes are featured in the evaporators and condensers. The 5300 ft cold water pipes descend to a 2100 ft depth, and are made of foam core fiberglass. The 350 ft warm water pipe has an intake at 35 ft depth and requires single wall fiberglass construction. The total plant cost is projected as \$63.7 million, with power delivery costs of 17 cents/kWh. DOE

N83-29863# TRW Energy Systems, Redondo Beach, Calif.
COAL-FIRED MHD COMBUSTION DEVELOPMENT PROJECT: PHASE 3B Quarterly Technical Progress Report, 13 Jan. - 30 Apr. 1982

20 May 1983 30 p

(Contract DE-AC22-81PC-40502)

(DE82-015176; MDH-III-82-072, QTPR-1) Avail: NTIS HC A03/MF A01

The first quarterly technical progress report of the Coal Fired MHD Combustor Development Project (Phase IIIB) presents the accomplishments during the period 13 January to 30 April, 1982. The scope of work covered by this quarterly report relates to those tasks associated with preparing the TRW 20 MW/sub t/ MHD coal combustor for delivery to AERL for integrated power tests and the work associated with the preliminary design of a 50 MW/sub t/ coal-fired combustor. Progress during this reporting period is described. All new 20 MW/sub t/hardware was designed and fabricated. Interface coordination meetings were conducted with AERL and DOE. Interface control drawings were completed and a 20 MW/sub t/coal combustion User's manual was delivered to AERL. The User's manual contained a shipping plan, a crew training plan, an assembly manual, interface documentation and recommended operating procedures. DOE

N83-30216# California Univ., Livermore. Lawrence Livermore Lab.

AN INDUCTIVE-STORE, PULSED POWER SOURCE

R. H. BARLETT and H. T. TAKEMORI Apr 1982 22 p refs
 (Contract W-7405-ENG-48)

(DE82-015443; UCID-19382) Avail: NTIS HC A02/MF A01

Design considerations and experimental results of an inductive store, pulsed source are presented. A 100 mm diameter, gun-fired projectile of approximately 2MJ kinetic energy was the input energy source. An initial magnetic field was trapped and compressed by the projectile. With a shorted load, a megajoule in a nanohenry was the design goal, i.e., 50% energy transformation from kinetic to magnetic. Five percent conversion was the highest recorded before gauge failure. DOE

N83-30238# JAYCOR, Alexandria, Va.

MODELING OF IMPOLODED ANNULAR PLASMAS Final Report, 1 Nov. 1980 - 1 Nov. 1981

J. U. GILLORY and R. E. TERRY 1 Apr. 1982 42 p refs

(Contract DNA001-79-C-0189)

(AD-A126179; AD-E301079; DNA-6152F; JAYCOR-J207-82-009)

Avail: NTIS HC A03/MF A01 CSCL 10B

During this period the primary emphasis has been on developing improved one-dimensional MHD code techniques for imploding plasma with radiative energy flow, in diode electromagnetic cavities. Other computational tools necessary for this, including smooth interpolator routines, have also been developed for use in various parts of the NRL program modeling plasma radiation sources. These computational developments are summarized in Part A of this report and details are given in an accompanying technical report. GRA

N83-30246# Los Alamos Scientific Lab., N. Mex.

STATISTICAL MAGNETOHYDRODYNAMICS AND REVERSED-FIELD-PINCH QUIESCENCE

L. TURNER 1982 24 p refs. Presented at the Conf. on New Trends in Unconventional Approaches to Magnetic Fusion, Stockholm, 16-18 Jun. 1982. Submitted for publication (Contract W-7405-ENG-36)

(DE82-015740; LA-UR-82-1358, CONF-820644-1) Avail: NTIS HC A02/MF A01

A statistical model of a bounded, incompressible, cylindrical magnetofluid is presented. This model predicts the presence of magnetic fluctuations about a cylindrically-symmetric, Bessel-function-model, mean magnetic field, which satisfies $\nabla \times B = \mu B$. As $\theta \rightarrow 1/56$, the model predicts that the significant part of the fluctuation spectrum narrows down to a single (coherent) $m = 1$ mode. An analog between the Debye length of an electrostatic plasma and $1/\mu$ suggests the physical validity of the model's predictions of $\delta B(r)$ when $r/r' \rightarrow 1/\mu$. DOE

N83-30250# California Univ., Livermore. Lawrence Livermore Lab.

INERTIAL FUSION: AN ENERGY-PRODUCTION OPTION FOR THE FUTURE

J. HOVINGH, J. H. PITTS, M. J. MONSLER, and G. R. GROW May 1982 18 p refs. Presented at the 17th Intersoc. Conversion Eng. Conf., Los Angeles, 8-13 Aug 1982

(Contract W-7405-ENG-48)

(DE82-019245; UCRL-87671; CONF-820814-20) Avail: NTIS HC A02/MF A01

The inertial confinement approach to fusion energy is discussed. After explaining the fundamentals of fusion, they describe the state of the art of fusion experiments, emphasizing the results achieved through the use of neodymium doped glass lasers at Lawrence Livermore National Laboratory and at other laboratories. They highlight recent experimental results confirming theoretical predictions that short wavelength lasers have excellent energy absorption on fuel pellets. Compressions of deuterium tritium fuel of over 100 times liquid density have been measured, only a factor of 10 away from the compression required for a commercial reactor. Finally, it is shown how to exploit the unique characteristics

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of inertial fusion to design reactor chambers that have a very high power density and a long life, features that the authors believe will eventually lead to fusion power at a competitive cost DOE

N83-30263# National Science Foundation, Washington, D.C. Div. of Policy Research and Analysis.

A WORKSHOP ON ALTERNATIVE FUSION CONCEPTS AND THEIR UTILIZATION PROJECTIONS

1982 264 p Workshop held in Washington, D.C., 9-10 Jan. 1980

(PB83-157966; NSF/PRA-82045; NSF-82-78) Avail: NTIS HC A12/MF A01 CSCL 18A

The role of alternate fusion concepts in overall fusion energy development is intimately related to the strategy of the fusion research and development program. Projection of fusion utilization is highly uncertain because the need for fusion energy depends on several factors: U.S. energy demand; conventional energy supplies; and the availability and utility of other alternate energy resources. The criteria which a fusion reactor must meet to compete economically with other energy resources are discussed and various options and alternative strategies for the development of fusion energy are proposed. The materials problem is recognized as a key problem of fusion research and more indepth materials studies should be carried out on the problem of first wall/blanket/coolant combinations. GRA

06

ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A83-31518

DEVELOPMENT AND PRODUCTION OF ADVANCED COOLING TECHNIQUES FOR HYBRID MICROCIRCUITS

K. S. SEKHON, SR. (Hughes Aircraft Co., Fullerton, CA) IN. Enhancement of quality through environmental technology; Proceedings of the Twenty-eighth Annual Technical Meeting, Atlanta, GA, April 21-23, 1982. Mt. Prospect, IL, Institute of Environmental Sciences, 1982, p. 108-112.

(Contract DAAK40-C-0141)

Heat pipe cooling techniques can be used to help solve the growing need for improved cooling of high-power, high-speed hybrid packaged microcircuits. The feasibility of this concept has been demonstrated by building and testing heat-pipe-cooled microcircuits. Here, a program is described whose objective is to translate this concept into a manufacturing process in order to make heat-pipe-cooled microcircuits available for military electronic systems. A pilot production line has been developed which has produced a total of 50 heat-pipe-cooled hybrid packs of two different types. A heat pipe production facility has been designed that can assemble, fill, and test hybrid microcircuit heat pipes at a rate of 100 per 8-hr shift. The basic production methods and processes are discussed. V.L.

A83-32704*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ALUMINUM/AMMONIA HEAT PIPE GAS GENERATION AND LONG TERM SYSTEM IMPACT FOR THE SPACE TELESCOPE'S WIDE FIELD PLANETARY CAMERA

J. A. JONES (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 8 p. NASA-supported research. refs (AIAA PAPER 83-1428)

In the Space Telescope's Wide Field Planetary Camera (WFPC) project, eight heat pipes (HPs) are used to remove heat from the camera's inner electronic sensors to the spacecraft's outer, cold

radiator surface. For proper device functioning and maximization of the signal-to-noise ratios, the Charge Coupled Devices (CCD's) must be maintained at -95 C or lower. Thermoelectric coolers (TEC's) cool the CCD's, and heat pipes deliver each TEC's nominal six to eight watts of heat to the space radiator, which reaches an equilibrium temperature between -15 C to -70 C. An initial problem was related to the difficulty to produce gas-free aluminum/ammonia heat pipes. An investigation was, therefore, conducted to determine the cause of the gas generation and the impact of this gas on CCD cooling. In order to study the effect of gas slugs in the WFPC system, a separate HP was made. Attention is given to fabrication, testing, and heat pipe gas generation chemistry studies. G.R.

A83-32705#

HIGH-CAPACITY HONEYCOMB PANEL HEAT PIPES FOR SPACE RADIATORS

H. J. TANZER (Hughes Aircraft Co., Torrance, CA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 12 p. refs (AIAA PAPER 83-1430)

The integral heat-pipe honeycomb panel structure is evaluated for application to future space platforms as lightweight, reliable, and highly efficient radiators. Performance predictions and structural development of a representative 120 by 24 by 0.25-in depth segment of a full-sized modular radiator fin is presented. The panel design utilizes an all-welded stainless steel wickable honeycomb core and facesheet construction, and methanol working fluid for the operating temperature range of -20 to 65 C. Critical parameters affecting heat-pipe thermal transport capacity are isolated, and current fabrication constraints are identified. In addition, several new concepts for an alternative high performance mode of radiator operation using heat-pipe panel structures are described. Based on work presented in previous development, and the performance predictions and hardware design described herein, the internally wickable core panel appears to be a viable concept for highly efficient space radiators; however, additional in-depth hardware development and testing will determine the optimum combination of materials, core configuration, and manufacturing technique. Author

A83-32706#

MONOGROOVE HEAT PIPE DEVELOPMENT FOR THE SPACE CONSTRUCTIBLE RADIATOR SYSTEM

J. ALARIO, R. BROWN, and R. KOSSON (Grumman Aerospace Corp., Bethpage, NY) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 9 p. (AIAA PAPER 83-1431)

A high-capacity, high-reliability space radiator is needed in order to satisfy the future heat rejection requirements of large space platforms or space stations. The Space Constructible Radiator (SCR) system is being developed to fill this need. The most important component of the SCR system is the high-capacity monogroove heat pipe which theoretically has a heat transport capacity of 12,700 W-m to 25,400 W-m. This performance represents a better than two order of magnitude increase in transport capacity over currently existing heat pipes. The present investigation is concerned with testing developments which occurred in connection with the monogroove heat pipe during the last two years. A short description of the SCR system is presented, and results are provided for two series of tests which were run on a 15.7-m long heat pipe. The first test series included both performance and diagnostic tests, which pointed to some design modifications which were necessary. The second test series, run on the modified heat pipe, showed improved performance. G.R.

A83-32707#

PERFORMANCE LIMITS FOR SMOOTH-WALL, GRAVITY-ASSISTED HEAT PIPES

F. C. PRENGER, J. E. KEMME (Los Alamos National Laboratory, Los Alamos, NM), M. GROLL, and T. SPENDEL (Stuttgart, Universitaet, Stuttgart, West Germany) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 5 p. refs (AIAA PAPER 83-1433)

Performance limits for vertical, smooth-wall heat pipes were obtained from experiments performed at the IKE of the University of Stuttgart and at the Los Alamos National Laboratory. The data are correlated with parameters derived from flooding in countercurrent, two-phase flows. Tests using smooth-walled, wickless heat pipes demonstrate the applicability of two-phase flow correlations for predicting performance limits in gravity-assisted heat pipes

Author

A83-32761#

DEVELOPMENT AND TEST OF A SPACE REACTOR CORE HEAT PIPE

M. A. MERRIGAN, J. E. RUNYAN, H. E. MARTINEZ, and E. S. KEDDY (Los Alamos National Laboratory, Los Alamos, NM) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 18th, Montreal, Canada, June 1-3, 1983. 10 p. refs (AIAA PAPER 83-1530)

A heat pipe designed to meet the heat transfer requirements of a 100 kW electrical power space nuclear power system has been developed and tested. General design requirements for the device included an operating temperature of 1500 K with an evaporator radial flux density of 100 W/sq cm. The total heat pipe length of 2 m comprised an evaporator length of 0.3 m, a 1.2 m adiabatic section, and a condenser length of 0.5 m. A four artery design was used with lithium serving as the working fluid. Molybdenum alloys were used for the screen materials and tube shell. Hafnium and zirconium gettering materials were used in connection with a prepurified distilled lithium charge to ensure internal chemical compatibility. The pipe was operated successfully at an axial power level greater than 10 kW/sq cm for 100 hrs at 1500 K. The tests demonstrated both the adequacy of the design and the short-term compatibility of the materials

C.D.

A83-33619

HEAT EXCHANGERS: THEORY AND PRACTICE

J. TABOREK, ED (Heat Transfer Research, Inc., Alhambra, CA), G. F. HEWITT, ED (U.K. Atomic Energy Authority, Engineering Sciences Div., Harwell, Berks., England), and N. AFGAN (International Centre for Heat and Mass Transfer, Belgrade, Yugoslavia) Washington, DC, Hemisphere Publishing Corp., 1983, 990 p.

The design, techniques, and application of heat exchangers (HE) for the recycling of energy in industry are surveyed, with a focus on current industrial experience and practical testing. Topics covered include evaporation/condensation, heat transfer and pressure drop in tube banks, HE-tube vibration, air-cooled HE, compact HE, fluidized-bed systems, regenerative HE, HE design, HE for power-generation systems and fouling in HE. Also covered are the performance of enhancement devices such as internally finned tubes, spirally fluted tubing, and static mixers for very viscous fluids.

T.K

A83-34471

HEAT TRANSFER IN THE EVAPORATION AND CONDENSATION ZONES OF HEAT PIPES INTENSELY HEATED AT THE END [TEPLOOTDACHA V ZONAKH ISPARENIIA I KONDENSATSII TEPLYVYKH TRUB PRI INTENSIVNOM OBOGREVE IKH TORTSA]

IU. F. GORTYSHOV, V. I. MARATKANOV, F. N. DRESVIANNIKOV, and N. N. DUNINA (Kazanskii Aviatsonnyi Institut, Kazan, USSR) Inzhenerno-Fizicheskii Zhurnal (ISSN 0021-0285), vol. 44, May 1983, p. 709-714. In Russian. refs

A83-39849

CRITICAL HEAT FLUX IN A CLOSED TWO-PHASE THERMOSYPHON

H. IMURA, K. SASAGUCHI, H. KOZAI (Kumamoto University, Kumamoto, Japan), and S. NUMATA (Kawasaki, Heavy Industries, Ltd., Kobe, Japan) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 26, Aug 1983, p. 1181-1188. refs

An experimental study was made of critical heat flux in a closed two-phase thermosyphon. The effects of inside diameter, heated length, working liquid, fill charge and inside temperature on the critical heat flux were investigated. The present and previously-published experimental data were correlated with expressions already proposed by other investigators but the agreements were not good. Accordingly, a new correlating expression was derived. This expression agrees with the experimental data within + or - 30 percent accuracy. Also, discussion of the adequate fill charge is made.

Author

A83-39850

HEAT TRANSFER PERFORMANCE OF AN INCLINED TWO-PHASE CLOSED THERMOSYPHON

K. NEGISHI and T. SAWADA (Osaka Prefecture, University, Sakai, Japan) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 26, Aug. 1983, p. 1207-1213. refs

An experimental study on the heat transfer performance of an inclined two-phase closed thermosyphon is described. Water and ethanol have been used as the working fluids. The amount of working fluid and the inclination angle have been used as the experimental parameters. A visualization of the movement of liquid with boiling, the scattering of liquid drops and the condensation of vapor has made clear the heat transfer mechanism in the thermosyphon. In addition, the overall heat transfer coefficients and the thermal diode characteristics have been obtained.

Author

N83-23916# California Univ., Livermore. Lawrence Livermore Lab. Fusion/Synfuels Program.

ANALYTICAL STUDY OF LIQUID METAL HEAT PIPES IN A MAGNETIC FIELD M.S. Thesis

N. SCHWERTZ 25 Aug 1982 110 p refs

(Contract W-7405-ENG-48)

(DE83-002091; UCID-19540) Avail NTIS HC A06/MF A01

The use of liquid metal heat pipes in a magnetic field was investigated. This was accomplished in two steps. A set of modified heat pipe equations to predict the heat transfer capability of a liquid metal heat pipe for the following special conditions was developed: operation in a magnetic field; nonuniform heating of the evaporator; and variable area adiabatic section. These equations were used in a computer code to model the thermal hydraulic performance of a liquid metal heat pipe for a specific design example.

DOE

N83-24552# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN CONSIDERATIONS FOR LARGE SPACE ELECTRIC POWER SYSTEMS

D. D. RENZ, R. C. FINKE, N. J. STEVENS, J. E. TRINER, and I. G. HANSEN Apr. 1983 23 p refs

(NASA-TM-83064; E-1535, NAS 1 15:83064) Avail. NTIS HC

A02/MF A01 CSCL 22B

As power levels of spacecraft rise to the 50 to 100 kW range, it becomes apparent that low voltage (28 V) dc power distribution and management systems will not operate efficiently at these higher power levels. The concept of transforming a solar array voltage at 150 V dc into a 1000 V ac distribution system operating at 20 kHz is examined. The transformation is accomplished with series-resonant inverter by using a rotary transformer to isolate the solar array from the spacecraft. The power can then be distributed in any desired method such as three phase delta to delta. The distribution voltage can be easily transformed to any desired load voltage and operating frequency. The reasons for the voltage limitations on the solar array due to plasma interactions

06 ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

and the many advantages of a high voltage, high frequency at distribution system are discussed. S.L.

N83-24806*# Texas A&M Univ., College Station. Dept. of Engineering Technology
COMPUTER MODELING OF HEAT PIPE PERFORMANCE Final Report

G P PETERSON 13 Jan 1983 26 p refs
(Contract NAS9-16606)
(NASA-CR-171641; NAS 1.26.171641) Avail. NTIS HC A03/MF A01 CSCL 20D

A parametric study of the defining equations which govern the steady state operational characteristics of the Grumman monogroove dual passage heat pipe is presented. These defining equations are combined to develop a mathematical model which describes and predicts the operational and performance capabilities of a specific heat pipe given the necessary physical characteristics and working fluid. Included is a brief review of the current literature, a discussion of the governing equations, and a description of both the mathematical and computer model. Final results of preliminary test runs of the model are presented and compared with experimental tests on actual prototypes M.G.

N83-24819*# Los Alamos Scientific Lab., N. Mex.
LONG TITANIUM HEAT PIPES FOR HIGH-TEMPERATURE SPACE RADIATORS

S. P. GIRRENS and D. M. ERNST (Thermacore, Inc., Lancaster, Pa.) 1982 6 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8-13 Aug 1982
(Contract W-7405-ENG-36)
(DE82-014069; LA-UR-81-1054; CONF-820814-2) Avail. NTIS HC A02/MF A01

Titanium heat pipes are being developed to provide light weight, reliable heat rejection devices as an alternate radiator design for the Space Reactor Power System (SP-100). The radiator design includes 360 heat pipes, each of which is 5.2 m long and dissipates 3 kW of power at 775 K. The radiator heat pipes use potassium as the working fluid, have two screen arteries for fluid return, a roughened surface distributive wicking system, and a D shaped cross section container configuration. A prototype titanium heat pipe, 5.5 m long, was fabricated and tested in space simulating conditions. Results from startup and isothermal operation tests are presented. These results are also compared to theoretical performance predictions that were used to design the heat pipe initially. DOE

N83-24822# Los Alamos Scientific Lab., N. Mex.
ARTERY HEAT PIPES FOR SPACE-POWER SYSTEMS
M. MERRIGAN, C. PRENGER, H. E. MARTINEZ, and J. RUNYAN 1982 7 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8 Aug. 1982
(Contract W-7405-ENG-36)
(DE82-015445; LA-UR-82-1270, CONF-820814-12) Avail. NTIS HC A02/MF A01

High temperature liquid metal heat pipes are developed as part of the SP-100 space power system. The operating temperature of the heat pipes is in the 1400 to 1500 K range and the design power level is 15 kW pipe. Baseline design for the heat pipes is an arterial configuration using a fine mesh screen for the arteries and distribution wick. Performance predictions for this configuration were conducted and the designs characterized as a function of artery geometry, distribution wick thickness, porosity, pore size, and permeability. In parallel with this effort the screen wick materials were characterized experimentally in terms of pore size and permeability. As a verification of the performance predictions a heat pipe employing two tubular arteries and a distribution wick of tightly compacted, 150 mesh molybdenum screen was assembled and operated with sodium as a working fluid. DOE

N83-25147# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF HIGH-TEMPERATURE LIQUID-METAL HEAT PIPES FOR ISOTHERMAL IRRADIATION ASSEMBLIES
E. S. KEDDY and H. E. MARTINEZ 1982 6 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8-13 Aug 1982
(Contract W-7405-ENG-36)
(DE82-016073; LA-UR-82-1273; CONF-820814-8) Avail. NTIS HC A02/MF A01

This paper describes the development of high-temperature heat pipes and their operating performance using liquid metal working fluids to provide high heat transfer assemblies for in-pile testing of UO₂ fuel. The fuel assembly consists of thin UO₂ wafers sandwiched between molybdenum discs, and is one of the components of the space nuclear reactor electrical power plant currently under development. The intended operation of the heat pipes is to control the temperature of the UO₂ irradiation experiment in the Experimental Breeder Reactor (EBR-II). This application involves vertical operation in a gravity-assist mode, with the evaporator end down. Heat pipe construction and preparation techniques are described. Laboratory tests were made and the performance characteristics determined. Test results are compared with calculated heat transfer limit. DOE

N83-26038# Societe Anonyme Belge de Constructions Aeronautiques, Brussels (Belgium).

DEVELOPMENT OF SMALL CRYOGENIC HEAT PIPES, PHASE 3 REPORT

J. P. MATHIEU Paris ESA Sep 1982 149 p refs
(Contract ESA-3737/78)
(JPM/LN/H05/N106, ESA-CR(P)-1700) Avail. NTIS HC A07/MF A01

Stainless steel heat pipes of 3 and 6 mm diameter featuring a mesh capillary, charged with either ethane, methane, nitrogen or oxygen, 1 m and 0.35 m in length and with 0.8, 0.2 and 0.1 m condenser lengths were submitted to determination of their maximum power versus temperature and versus tilt. Priming behavior, burst pressure, leak detection technique, and resistance to sine and random vibrations were studied. Information concerning these features is used to complete a set of detail specifications for all the heat carriers concerned. Author (ESA)

N83-27730# Argonne National Lab., Ill.
STATUS OF THE ARGONNE SUPERCONDUCTING-LINAC HEAVY-ION BOOSTER

J. ARON, R. BENAROYA, L. M. BOLLINGER, B. E. CLIFFT, K. W. JOHNSON, P. MARKOVICH, J. M. NIXON, R. PARDO, K. W. SHEPARD, and G. ZINKANN In LASL Proc. of the 1981 Linear Accelerator Conf. p 25-28 Feb 1982 refs
(Contract W-31-109-ENG-38)
Avail. NTIS HC A17/MF A01

The Superconducting-Linac Heavy-Ion Booster is nearly complete. The linac now contains 22 of the complement of 24 resonators which will eventually be installed. During the construction period, the completed portion of the linac has provided useful beams for nuclear and atomic physics experimental programs. The linac control system was developed so that much of the more complex control functions are performed automatically. S.L.

N83-29284# Joint Publications Research Service, Arlington, Va
BEREGOVY ON FUTURE CONSTRUCTION IN SPACE
V. SKURATNIK In its USSR Rept. Space, No 22 (JPRS-83612) p 43-46 6 Jun. 1983 Transl into ENGLISH from Stroit Gazeta (Moscow), 29 Dec. 1982 p 4
Avail. NTIS HC A06

A Russian science fiction novel published in 1920 is quoted at length and used as a basis for discussion of space engineering in the present and the future. Greenhouses in space, solar electric power stations, and cities in space are discussed. R.J.F.

ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A83-31090**THE LEAD-ACID BATTERY - DEMONSTRATING THE SYSTEMS DESIGN APPROACH TO A PRACTICAL ELECTRIC VEHICLE POWER SOURCE**

M. G. ANDREW and C. E. WEINLEIN (Johnson Controls, Inc., Globe Battery Div., Milwaukee, WI) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 21-25 refs

A83-31091**ZINC-BROMINE BATTERY DESIGN FOR ELECTRIC VEHICLES**

R. J. BELLOWS, P. GRIMES, H. EINSTEIN, E. KANTNER, P. MALACHESKY, and K. NEWBY (Exxon Research Engineering Center, Linden, NJ) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 26-32. Research supported by the U.S. Department of Energy. refs

Design projections for zinc-bromine batteries are attractive for electric vehicle applications in terms of low manufacturing costs (\$28/kWh) and good performance characteristics. Zinc-bromine battery projections (60-80 Wh/kg, 130-200 W/kg) compare favorably to both current lead acid batteries and proposed advanced battery candidates. The performance of recently developed battery components with 1200 sq/cm electrodes in a 120V, 10 kWh module is described. Similarly constructed smaller scale (600 sq/cm) components have shown lifetimes exceeding 400 cycles and the ability to follow both regenerative braking (J227aD) and random cycling regimes. Initial dynamometer evaluations of full scale 20 kWh batteries is expected in early 1984. Author

A83-31097**ELECTRIC VEHICLE FIELD TEST EXPERIENCE**

J. R. BISH (General Motors Corp., Delco-Remy Div., Anderson, IN) and G. P. TIETMEYER (General Motors Corp., Truck and Coach Div., Pontiac, MI) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 81-89

Thirty-five experimental GMC electric vans accumulated over 300,000 miles in a field test application as telephone service and repair vehicles. Information was obtained on recharging lead-acid traction batteries which led to microprocessor control of the recharge. Energy consumption, ac kilowatt hours per mile, was greatly reduced and recharge efficiency increased by accurate control of the recharge. Battery energy density (range) and wear-out remain concerns which promote the need for a new energy source for commercial electric vehicles. Author

A83-31098**THE TIMING OF EV RECHARGING AND ITS EFFECT ON UTILITIES**

M. M. COLLINS (General Research Corp., Santa Barbara, CA) and G. H. MADER (Electric Power Research Institute, Palo Alto, CA) IEEE Transactions on Vehicular Technology (ISSN 0018-9545), vol. VT-32, Feb. 1983, p. 90-97. Research supported by Electric Power Research Institute refs

The impact of electric vehicles (EVs) on electric utilities will in part depend on when the vehicles are recharged. If electricity pricing practices were guided by time of day, recharging of EVs would occur at late night hours, when demand for electricity for other purposes is low. The peak demand by the year 2000 would then increase by only 400 MW, by comparison with 5700 MW for the case of electricity that is uniformly priced throughout the day. It is further established by the present projections that the oil- and gas-burning component of electrical generation would rise by only 27 percent for the late night-charging case, by contrast to 39

percent for the alternative, late afternoon and early evening recharging. O.C

A83-31599**ENERGY STORAGE IN A FUEL CELL WITH BIPOLAR MEMBRANES BURNING ACID AND HYDROXIDE**

A.T. EMREN and V. J. M. HOLMSTROM (Goteborg, Universitet, Goteborg, Sweden) Energy (UK) (ISSN 0360-5442), vol. 8, April 1983, p. 277-282. refs

A battery is described, in which bipolar membranes are used to split water into acid and hydroxide. The liquids may be stored for an indefinite time, and energy may be recovered at room temperature. It is shown that the liquids are able to store about 400 kJ/litre, which roughly corresponds to pumping water up to an altitude of 40 km. Bipolar membranes of low area resistance have been made and tested. The area resistance appears to have been 2-3 ohm sq cm. A battery containing 7 unit cells has been constructed and tested. The maximum output voltage has been 1.8 V. The cost for energy storage is estimated to range from \$0.1 to 2.5 per kWh depending on the mode of operation. Author

A83-32378**THE DESIGN OF FLYWHEELS MADE OF FIBROUS MATERIALS [K PROEKTIROVANIU MAKHOVIKOV, IZGOTOVLENNYKH IZ VOLOKNISTYKH MATERIALOV]**

IU. P. ROMASHOV and S. B. CHEREVATSKII (Kazanskii Khimiko-Tekhnologicheskii Institut, Kazan, USSR) Problemy Prochnosti (ISSN 0556-171X), April 1983, p. 13-17. In Russian refs

The feasibility of designing shell-type filament-wound composite flywheels is analyzed, with attention given to four different designs. These include flywheels of uniform strength, geodesic flywheels, pseudo-geodesic flywheels, and flywheels wound along the lines of constant deviation from the geodesic lines. The energy storage characteristics of these designs are discussed, as are certain limitations related to the manufacturing process. V.L

A83-32627* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPECTED CYCLE LIFE VS. DEPTH OF DISCHARGE RELATIONSHIPS OF WELL-BEHAVED SINGLE CELLS AND CELL STRINGS

L. H. THALLER (NASA, Lewis Research Center, Cleveland, OH) Electrochemical Society, Journal (ISSN 0013-4651), vol. 130, May 1983, p. 986-990.

The present investigation is concerned with the factors which might influence the cycle life vs. depth of discharge relationship, taking into account the rate of loss of cell capacity, the amount of excess capacity built into the cells, and the penalty in capacity loss resulting from the use of deep depths of discharge. 'First principles' are used to develop a cell life model for somewhat arbitrary conditions. This model is then used to estimate the cycle life vs. depth of discharge relationships for 'well behaved' cells. The stochastic variations associated with groupings of single cells are then introduced to the battery pack cycle life model. The term 'well behaved' cell is used to describe a single cell which does not suffer any abrupt failure mode during the course of its operation. It gradually loses capacity for any number of the usual reasons at a rate which is the product of the fractional depth of discharge and a factor which is characteristic of the cell under consideration. G.R.

A83-32630**VOLTAMMETRIC STUDY OF THE ANODIC OXIDATION OF SULFIDE IONS IN MOLTEN FLUORIDES**

N. Q. MINH and N.-P. YAO (Argonne National Laboratory, Argonne, IL) Electrochemical Society, Journal (ISSN 0013-4651), vol. 130, May 1983, p. 1025-1029. Research sponsored by the U.S. Department of Energy. refs

Information regarding the electrochemical behavior of sulfide ions in molten salts is important for questions of battery technology in the case of high-temperature secondary batteries, and for metallurgical molten-salt processes. The present investigation is

concerned with the electrochemical behavior of sulfide in molten LiF-NaF. The investigation has the objective to evaluate the feasibility of the LiF-NaF melt as solvent for the electrolysis of Al₂S₃. The results are presented of a voltammetric study of the electrochemical oxidation of sulfide in LiF-NaF eutectic at 1023 K. It is found that the anodic oxidation of sulfide ions in LiF-NaF eutectic is reversible and diffusion controlled. The obtained experimental data correspond to the reaction mechanism 2S(2-) yields reversibly S₂(2-) + 2e(-). G.R.

A83-32647

ELECTROCHEMICAL UTILIZATION OF METAL HYDRIDES

H. F. BITTNER and C. C. BADCOCK (Aerospace Corp., Chemistry and Physics Laboratory, Los Angeles, CA) Electrochemical Society, Journal (ISSN 0013-4651), vol. 130, May 1983, p. 193C-198C. refs
(Contract F04701-81-C-0082)

Fundamental and applied works involving the electrochemical utilization of metal hydrides are reviewed. In the first part of the paper, studies that investigated metal hydrides for hydrogen storage in nickel hydrogen batteries are reviewed. These studies showed that use of hydrides lowered the operating pressures in nickel hydrogen cells, which could lead to improved energy density. However, results regarding degradation of the hydriding material in an aqueous medium were conflicting. In the second part of the paper, the use of metal hydrides as reversible hydrogen electrodes is discussed. Studies reviewed included thermodynamic and kinetic investigations of a variety of hydriding materials. Conflicting results among studies are reconciled where possible, and conclusions are drawn regarding the feasibility of electrochemical utilization of metal hydrides, with suggestions for further work. Author

A83-37547

MINIMIZATION OF ENERGY STORAGE REQUIREMENTS FOR INTERNAL COMBUSTION ENGINE HYBRID VEHICLES

C. R. BURROWS (Strathclyde University, Glasgow, Scotland), C. ANSCOMB, and N. H. BEACHLEY ASME, Transactions, Journal of Dynamic Systems, Measurement and Control (ISSN 0022-0434), vol. 105, June 1983, p. 113-119. Research supported by the Science and Engineering Research Council and University of Wisconsin. refs

The use of energy storage in an automobile provides two important fuel-saving advantages: first the engine can be run at or close to its condition of maximum efficiency, and secondly the energy of braking can be recovered regeneratively. This paper examines how these factors are linked to the size of the energy storage unit and describes a control policy which has the purpose of minimizing the capacity while retaining the fuel-saving benefits. Both flywheel and accumulator storage units are considered; results are obtained for three standard test cycles. Some preliminary attempts are made to assess the effect of road gradient. It is concluded that a capacity of the order of 0.15 to 0.20 MJ for a 1360 kg automobile would provide most of the fuel-saving benefits for typical driving patterns where grade is not an important consideration. Author

A83-39624

MATHEMATICAL ANALYSIS OF A ZN/NIOOH CELL

H. GU (GM Research Laboratories, Warren, MI) Electrochemical Society, Journal (ISSN 0013-4651), vol. 130, July 1983, p. 1459-1464. refs

A mathematical model has been developed to predict the time dependent behavior of a Zn/NiOOH cell. The model uses experimentally determined polarization expressions to describe the losses between the positive and the negative electrodes. The electronic losses in the plane of the electrode are simulated by a network of resistors. The potential distribution, the current distribution, the cell voltage, the power capability, and the energy of a cell can be predicted. The mathematical model provides an analytical tool to evaluate, for example, the trade-offs between power capability and current collector mass, needed to design an electric vehicle battery. Author

A83-40294

COMPOSITE FLYWHEEL ROTOR CONTAINMENT

A. P. COPPA (General Electric Co., Space Systems Div., Philadelphia, PA) and S. V. KULKARNI (California, University, Livermore, CA) IN: Progress in science and engineering of composites; Proceedings of the Fourth International Conference on Composite Materials, Tokyo, Japan, October 25-28, 1982. Volume 2. Tokyo/Amsterdam, Japan Society for Composite Materials/North-Holland, 1982, p. 1749-1758. Research sponsored by the U.S. Department of Energy. refs

New advancements in the characterization and quantification of composite flywheel rotor burst behavior are contributing to the growing feasibility of vehicular energy storage systems. Attention is presently given to flywheel containment housing design requirements, together with a novel analysis of composite rotor containment action which considers fragments released upon rotor failure as undergoing a progressive crushing process during containment. This process is characterized by a constant parameter, the apparent fragment crushing strength, which is defined as the ability of fragments to resist progressive breakdown under the applied containment forces. This analysis has been successfully applied to the correlation of containment test behavior for a variety of high performance composite rotors. Burst-containment weight estimates based on the analysis are also given. O.C.

N83-23535# Los Alamos Scientific Lab., N. Mex

SUPERCONDUCTING MAGNETIC ENERGY STORAGE FOR BPA TRANSMISSION-LINE STABILIZATION

J. D. ROGERS, M. H. BARRON, H. J. BOENIG, A. L. CRISCUOLO, J. W. DEAN, and R. I. SCHERMER 1982 4 p refs Presented at the Appl. Superconductivity Conf., Knoxville, Tenn., 30 Nov - 3 Dec. 1982

(Contract W-7405-ENG-36)

(DE83-000640; LA-UR-82-2719; CONF-821108-3) Avail: NTIS HC A02/MF A01

The Bonneville Power Administration (BPA) operates the electrical transmission system that joins the Pacific Northwest with southern California. A 30 MJ (8.4 kWh) Superconducting Magnetic Energy Storage (SMES) unit with a 10 MW converter is being installed at the Tacoma Substation to provide system damping for low frequency oscillations of 0.35 Hz. The integrated system status is described and reviewed. Components included in the system are the superconducting coil, seismically mounted in an epoxy fiberglass nonconducting dewar; a helium refrigerator; a heat rejection subsystem; a high pressure gas recovery subsystem; a liquid nitrogen trailer; the converter with power transformers and switchgear, and a computer system for remote microwave link operation of the SMES unit. DOE

N83-23562# Pacific Northwest Lab., Richland, Wash.

MULTI-DIMENSIONAL FINITE-ELEMENT CODE FOR THE ANALYSIS OF COUPLED FLUID ENERGY, AND SOLUTE TRANSPORT (CFEST)

S. K. GUPTA, C. T. KINCAID, P. R. MEYER, C. A. NEWBILL, and C. R. COLE Aug. 1982 93 p refs

(Contract DE-AC06-76RL-01830)

(DE82-022521; PNL-4260) Avail: NTIS HC A05/MF A01

The Seasonal Thermal Energy Storage Program is being conducted for the Department of Energy by Pacific Northwest Laboratory. A major thrust of this program has been the study of natural aquifers as hosts for thermal energy storage and retrieval. Numerical simulation of the nonisothermal response of the host media is fundamental to the evaluation of proposed experimental designs and field test results. This report represents the primary documentation for the coupled fluid, energy and solute transport code. Sections of this document are devoted to the conservation equations and their numerical analogues, the input data requirements, and the verification studies completed to date. DOE

N83-23642# Sandia Labs., Albuquerque, N. Mex. Applied Mechanics Div.

USE OF LABORATORY TRIAXIAL-CREEP DATA AND FINITE-ELEMENT ANALYSIS TO PREDICT OBSERVED CREEP BEHAVIOR OF LEACHED SALT CAVERNS

D. S. PREECE and C. M. STONE Aug. 1982 33 p refs

(Contract DE-AC04-76DP-00789)

(DE82-022235; SAND-82-0678) Avail: NTIS HC A03/MF A01

The use of leached salt caverns to store oil and natural gas was examined. A critical factor in the use of existing caverns and the design of new ones is the creep behavior of the salt surrounding the caverns. Laboratory triaxial creep data as material property input to finite element computer programs designed to calculate displacements and stresses due to creep are used. A step in verifying these predictive methods is the comparison of field data from existing caverns with finite element analyses which incorporate the material properties and geometry of each site. This comparison has been made for caverns in the Eminence Dome (Mississippi), West Hackberry Dome (Louisiana), and Bayour Chocktaw dome (Louisiana) and reasonably good correlation is obtained between measured and predicted volumetric response of the caverns.

DOE

N83-23793# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

ADVANCED, HIGH-TEMPERATURE MOLTEN-SALT STORAGE

R. J. COPELAND Aug. 1982 8 p refs Presented at the Energy Storage Contractors' Rev Meeting, Washington, D.C., 23-26 Aug 1982

(Contract DE-AC02-76CH-00178; EG-77-C-01-4042)

(DE82-020852, SERI/TP-252-1684, CONF-820827-23) Avail:

NTIS HC A02/MF A01

Advanced molten salts (hydroxides, carbonates, and chlorides) are being researched for solar thermal applications. These salts may be used in both the receiver working fluid and in thermal energy storage. Potential applications include electric power production, fuel and chemical production, and high-temperature process heat. Molten salts can store sensible heat at temperatures up to 1100 C in a thermocline system with a unique insulating platform (raft) that floats between the hot and cold molten salts. Overall solar economic potential of the systems is assessed. In current research, the performance of insulating raft thermocline is being tested and materials compatibility is being studied. DOE

N83-23809# Rocket Research Corp., Redmond, Wash

SULFURIC ACID/WATER CHEMICAL HEAT PUMP

E. C. CLARK /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 55-58 Mar. 1982 refs

Avail: NTIS HC A11/MF A01

A sulfuric acid chemical heat pump chemical energy storage, CHP/CES, verification test unit (VTU) which incorporates as many commercial, mass producible design features as necessary to demonstrate system economic and technical feasibility is designed, constructed, and tested. The VTU is designed to function both as a storage HVAC unit and a temperature enhancement industrial heat pump. For purposes of gaining scaling criteria, the nominal storage design capacity shall be 10 million Btu with a nominal delivered heat rate of 150,000 Btu/hr. S.L.

N83-23829# Research Triangle Inst., Research Triangle Park, N.C.

STEADY-STATE PERFORMANCE CHARACTERISTICS OF LATENT HEAT TES/HEAT PUMP SYSTEMS

T. W. SIGMON /in DOE Proc. of the DOE Heat Pump Contractors' Program Integration Meeting p 194-197 Mar 1982 refs

(Contract DE-AC01-79ET-26707)

Avail: NTIS HC A11/MF A01

Two projects are currently being completed that wholly or in part address various technical issues involved in the implementation of heat pump systems combined with thermal energy storage (TES). The first of these involves the determination of steady state performance characteristics for six generic TES/heat pump configurations and the comparison of the operational performance

of these systems with other space heating and cooling TES technologies. Of these latter systems four are commercial or near commercial air conditioner or heat pump coupled TES systems. Steady state performance has been established for all systems. Operational performance and system life cycle cost has been determined for the six generic designs for a limited set of application conditions. The intent of the second project is to establish a reliable method of estimating seasonal energy use by TES/heat pump systems, to utilize this methodology to evaluate a large number of possible system designs, identify a small number of systems that merit more detailed analysis, and, to the extent possible, conduct these detailed studies Author

N83-23867# Oak Ridge National Lab., Tenn. Engineering Technology Div

ANALYSIS OF FIXED-BASE FLYWHEEL SYSTEMS FOR ELECTRIC-UTILITY APPLICATIONS

M. OLSZEWSKI 1982 6 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles, 8 Aug. 1982

(Contract W-7405-ENG-26)

(DE82-020809; CONF-820814-27) Avail: NTIS HC A02/MF A01

The potential role for flywheels as a utility storage option and establish research and development priorities for fixed base flywheel systems were assessed. The demand for electricity exhibits diurnal, weekly, and seasonal variations. Because of these variations utilities experience off-peak times when the baseload generation capacity is not fully utilized. They experience on peak loads substantially in excess of baseload generation capability. The use of energy storage allows the cheaper base load generation to be used in place of expensive oil-fired combustion turbine power for peaking applications. The very short-term peaking spikes experienced by utilities were studied. This represents about 4% of the total annual amount of energy generated by utilities but about 13% of the total fuel costs. DOE

N83-23939# Sandia Labs., Albuquerque, N. Mex.

STATUS OF FLOW-BATTERY RESEARCH IN THE UNITED STATES

R. P. CLARK, J. L. CHAMBERLIN, H. J. SAXTON, and P. C. SYMONS (Electrochemical Engineering Consultants, Inc.) 1982

26 p refs Presented at the 13th Intern. Power Sources Symp., Brighton, England, 27 Sep 1982

(Contract DE-AC04-76DP-00789)

(DE82-020963, SAND-82-2055C; CONF-820907-3) Avail: NTIS HC A03/MF A01

Flow batteries are defined as electrochemical energy storage devices in which at least one of the active materials is stored external to the power converting cell stack, and in which this soluble active material is circulated via the electrolyte, through the cell-stack during system charge or discharge. Research is reported on the following systems: zinc/chlorine batteries, zinc/bromine batteries, iron/chromium redox batteries, iron/ferric-ferrous chloride batteries, and zinc/ferro-ferricyanide batteries DOE

N83-24388# California Univ., Berkeley. Lawrence Berkeley Lab Materials and Molecular Research Div

TWO-DIMENSIONAL TRIANGULAR LATTICE AND ITS APPLICATION TO LITHIUM-INTERCALATED LAYERED COMPOUNDS Ph.D. Thesis

R. O. DECERQUEIRA Aug 1982 105 p refs

(Contract DE-AC03-76SF-00098)

(DE82-021788, LBL-14815) Avail: NTIS HC A06/MF A01

Good rechargeable batteries are being searched for use in electric vehicles and in energy storage during off-peak consumption periods and from solar sources. The interest in lithium intercalation compounds has been recently enhanced by the search for such batteries. The process of intercalation of lithium in several transition metal dichalcogenides can provide an emf of several volts. The progress achieved in the last decade in the investigation of these intercalates has been facilitated by the availability of the dichalcogenides as single crystals and by their chemical stability.

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The transition-metal dichalcogenides and their Li-intercalates are studied, with emphasis on the $\text{Li}/\text{sub } x\text{Ta}/\text{sub } y\text{Ti}/\text{sub } 1-y/\text{S}_2$ series. The interactions between the Li atoms and the applicability of a lattice gas model to the problem of ordering of these atoms is discussed. A formulation is presented of the cluster-variation approximation to the lattice gas problem. The single-site and the nearest-neighbor triangle basic clusters are considered as models for $\text{Li}/\text{sub } x\text{TiS}_2$. Also a theory is presented for the effects of a random distribution of different species of host atoms, as in $\text{Ta}/\text{sub } y/\text{Ti}/\text{sub } 1-y/\text{S}_2$. DOE

N83-24571*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio.

PORE SIZE ENGINEERING APPLIED TO THE DESIGN OF SEPARATORS FOR NICKEL-HYDROGEN CELLS AND BATTERIES

K. M. ABBEY and D. L. BRITTON 1983 11 p refs Proposed for presentation at the 18th Intersoc. Energy Conversion Eng. Conf., Orlando, Fla., 21-26 Aug. 1983, sponsored by American Inst. of Chemical Engineers, IEEE, AIAA, American Chemical Society, ANS, ASME, and SAE
(NASA-TM-83386; E-1663, NAS 1 15 83386) Avail: NTIS HC A02/MF A01 CSCL 10C

Pore size engineering in starved alkaline multiplate cells involves adopting techniques to widen the volume tolerance of individual cells. Separators with appropriate pore size distributions and wettability characteristics (capillary pressure considerations) to have wider volume tolerances and an ability to resist dimensional changes in the electrodes were designed. The separators studied for potential use in nickel-hydrogen cells consist of polymeric membranes as well as inorganic microporous mats. In addition to standard measurements, the resistance and distribution of electrolyte as a function of total cell electrolyte content were determined. New composite separators consisting of fibers, particles and/or binders deposited on Zircar cloth were developed in order to engineer the proper capillary pressure characteristics in the separator. These asymmetric separators were prepared from a variety of fibers, particles and binders. Author

N83-24791# Eaton Corp., Southfield, Mich. Engineering and Research Center.

ELECTRIC-HYBRID-VEHICLE SIMULATION

D. C. PASMA 1982 7 p refs Presented at the US DOE Phys. and Chem. Storage Branch Contractors' Rev. Meeting, Arlington, Va., 23-26 Aug. 1982
(Contract W-7405-ENG-26)
(DE82-020838; CONF-820827-15) Avail: NTIS HC A02/MF A01

The simulation of electric hybrid vehicles is to be performed using experimental data to model propulsion system components. The performance of an existing ac propulsion system will be used as the baseline for comparative purposes. Hybrid components to be evaluated include electrically and mechanically driven flywheels, and an elastomeric regenerative braking system. DOE

N83-25038*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio.

CYCLE LIFE TEST AND FAILURE MODEL OF NICKEL-HYDROGEN CELLS

J. J. SMITHRICK 1983 16 p refs Proposed for presentation at the 18th Intersoc. Energy Conversion Eng. Conf., 21-26 Aug. 1983, sponsored by American Inst. of Chemical Engineers, IEEE, AIAA, American Chemical Society, ANS, ASME, and SAE
(NASA-TM-83375; E-1643, NAS 1.15 83375) Avail: NTIS HC A02/MF A01 CSCL 10C

Six ampere hour individual pressure vessel nickel hydrogen cells were charge/discharge cycled to failure. Failure as used here is defined to occur when the end of discharge voltage degraded to 0.9 volts. They were cycled under a low earth orbit cycle regime to a deep depth of discharge (80 percent of rated ampere hour capacity). Both cell designs were fabricated by the same manufacturer and represent current state of the art. A failure model was advanced which suggests both cell designs have inadequate volume tolerance characteristics. The limited existing data base at

a deep depth of discharge (DOD) was expanded. Two cells of each design were cycled. One COMSAT cell failed at cycle 1712 and the other failed at cycle 1875. For the Air Force/Hughes cells, one cell failed at cycle 2250 and the other failed at cycle 2638. All cells, of both designs, failed due to low end of discharge voltage (0.9 volts). No cell failed due to electrical shorts. After cell failure, three different reconditioning tests (deep discharge, physical reorientation, and open circuit voltage stand) were conducted on all cells of each design. A fourth reconditioning test (electrolyte addition) was conducted on one cell of each design. In addition post cycle cell teardown and failure analysis were performed on the one cell of each design which did not have electrolyte added after failure. Author

N83-25042*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio.

SINGLE CELL PERFORMANCE STUDIES ON THE FE/CR REDOX ENERGY STORAGE SYSTEM USING MIXED REACTANT SOLUTIONS AT ELEVATED TEMPERATURE

R. F. GAHN, N. H. HAGEDORN, and J. S. LING 1983 9 p refs Proposed for presentation at 18th Intersoc. Energy Conversion Eng. Conf., Orlando, Fla., 21-26 Aug. 1983
(Contract DE-AL04-80AL-12726)
(NASA-TM-83385; DOE/NASA/12726-21; E-1662; NAS 1.15-83385) Avail: NTIS HC A02/MF A01 CSCL 10C

Experimental studies in a 14.5 sq cm single cell system using mixed reactant solutions at 65 C are described. Systems were tested under isothermal conditions i.e., reactants and the cell were at the same temperature. Charging and discharging performance were evaluated by measuring watt-hour and coulombic efficiencies, voltage-current relationships, hydrogen evolution and membrane resistivity. Watt-hour efficiencies ranged from 86% at 43 ma/sq cm to 75% at 129 ma/sq cm with corresponding coulombic efficiencies of 92% and 97%, respectively. Hydrogen evolution was less than 1% of the charge coulombic capacity during charge-discharge cycling. Bismuth and bismuth-lead catalyzed chromium electrodes maintained reversible performance and low hydrogen evolution under normal and adverse cycling conditions. Reblending of the anode and cathode solutions was successfully demonstrated to compensate for osmotic volume changes. Improved performance was obtained with mixed reactant systems in comparison to the unmixed reactant systems. Author

N83-25045# Exide Management and Technology Co., Yardley, Pa.

REPORT FOR 1981 ON RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report

Mar. 1982 85 p refs

(Contract W-31-109-ENG-38)

(ANL/OPEN-81-12) Avail: NTIS HC A05/MF A01

Life testing of a 300 Ah cell was continued using the high rate dc charge and deep discharge at C/3 (100%). To date the cell has completed over 350 cycles, and capacity is still at 90% of nominal level. The four-cell 300 Ah module which was submitted to NBTL for testing failed prematurely because of a hydrogen explosion. This was originally thought to be caused by a material failure, but later testing indicated that a spark caused by a loose nodule of zinc was the cause of failure. A fix for this condition was effected, and no recurrence of this type of failure were seen. Experiments with electrolyte concentration were continued, and extended cycling (over 300 cycles) with higher concentrations of KOH (9M, 10M) resulted in higher capacities over an extended period. Experimental baseline modules (2-cell) based on the EV-106 lead-acid battery footprint and incorporating 1.5 mm interelectrode spacing were built and tested. Author

N83-25048# Lulea Univ. (Sweden). Water Resources Engineering Lulea.

HEAT STORAGE IN ROCK: MULTIPLE WELL SYSTEM

S. ANDERSSON (AIB Consulting Engineers, Stockholm, Sweden), A. ERIKSSON (AIB Consulting Engineers, Stockholm, Sweden), and B. NORDELL 1982 15 p refs Presented at the Energy Storage Conf., Seattle, 19-21 Oct. 1981 (TULEA-1981:28; ISSN-0347-0881) Avail NTIS HC A02/MF A01

The multiple well heat storage system is primarily a seasonal storage. Its function is based on the heat conductivity and storage capacity properties of the rock. The heat is transferred to or from the rock by means of a fluid, normally water, which is circulated through a great number of boreholes or wells Author

N83-25050# Sargent and Lundy, Engineers, Chicago, Ill. **COMPRESSED-AIR ENERGY-STORAGE PRELIMINARY DESIGN AND SITE-DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 7: ENVIRONMENTAL, SAFETY AND LICENSING CONSIDERATIONS Final Report**

Dec. 1982 368 p refs
(Contract DE-AC02-78ET-29232, ET-78-C-01-2159)
(DE83-005728; EPRI-EM-2351-VOL-7) Avail: NTIS HC A16/MF A01

The suitability of aquifers as compressed air energy storage (CAES) sites was examined. The methodology and results of the study are described. The probability, severity, and recommended control measures for the environmental and safety impacts that could result from the construction and operation of a CAES facility are outlined. The permits and approvals that would be required and the time estimated for their acquisition are also described. GRA

N83-25057# MCC Associates, Inc., Silver Spring, Md. **PROCEEDINGS OF THE SIXTH ANNUAL THERMAL AND CHEMICAL STORAGE CONTRACTORS' REVIEW MEETING**

Feb. 1982 399 p refs Meeting held in Washington, D.C., 14-16 Sep. 1981
(Contract W-7405-ENG-26)
(CONF-810940) Avail: NTIS HC A17/MF A01

Chemical/hydrogen energy systems, electrolytic and thermochemical hydrogen production, hydrogen storage/recovery, chemical heat pumps, thermal energy for building heating and cooling and for industrial applications, solar thermal applications, and research are discussed.

N83-25068# Southern California Gas Co., Los Angeles **METAL HYDRIDE/CHEMICAL HEAT PUMP DEVELOPMENT PROJECT**

H. A. MADARIAGA and D. A. ROHY (Solar Turbines, Inc., San Diego, Calif.) In MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev Meeting p 107-113 Feb. 1982 refs
Avail: NTIS HC A17/MF A01

A metal hydride heat pump (MHHP) is a chemical heat pump containing two different hydrides and using hydrogen as a working fluid for the storage and/or recovery of thermal energy. It utilizes the heat of reaction of hydrogen with specific metal alloys. The MHHP design can be tailored to provide heating and cooling or temperature upgrading over a wide range of input and ambient temperatures. This system can be used with a variety of heat sources including industrial waste heat, solar energy or a fossil fuel. Temperature as low as 130 F can drive the MHHP when a suitable sink is provided. A project is currently underway to develop this unique heat pump for a specific application. The goals of the project include the development of cost effective hydride containers with high heat transfer and low mass; design and fabrication of a laboratory evaluation model; and design and fabrication of a demonstration unit. Extensive component and system test will provide the data for the design processes. Author

N83-25072# Argonne National Lab., Ill. Special Projects Group. **FIELD EVALUATION AND ASSESSMENT OF THERMAL ENERGY STORAGE FOR RESIDENTIAL SPACE HEATING Interim Report**

H. HERSH In MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 161-165 Feb. 1982

Avail: NTIS HC A17/MF A01

A data base was developed based on two heating seasons and 45 test and 30 control homes in Maine and Vermont. Based on first analysis of monitored temperatures and electrical energy used for space heating, fuel bills and reports of users and utilities, the technical performance of TES ceramic and hydronic systems is deemed to be technically satisfactory and there is a high degree of customer acceptance and positive attitudes towards TES. Analysis of house data shows a high degree of variability in electric heat energy demand for a given degree-day. An analysis is underway to investigate relative differences in the efficiency of electricity utilization of storage and direct heating devices. The much higher price of storage systems relative to direct systems is an impediment to market penetration. A changing picture of rate structures may encourage direct systems at the expense of storage systems. L.F.M.

N83-25073# Argonne National Lab., Ill. Energy and Environmental Systems Div.

ASSESSMENT OF COOL STORAGE IN COMMERCIAL BUILDING APPLICATIONS

J. G. ASBURY, J. M. CALM, and R. F. GIESE In MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 166-175 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

As part of its storage assessment program, Argonne National Laboratory is evaluating cool storage technologies for electric load leveling in commercial building applications. Analysis of conventional chilled water and ice storage systems indicate that paybacks of less than four years are available under the partial storage, or load leveling, mode of operation. Storage systems with sufficient capacity to eliminate on-peak chiller operations entail larger initial capital outlays and longer paybacks under existing commercial-class electric rate schedules. Improved performance and lower costs could be achieved through R&D to improve the match between the storage and the chiller systems and through development of improved latent heat systems Author

N83-25074# Pennwalt Corp., King of Prussia, Pa. Central Research and Development.

PELLETIZATION AND ROLL ENCAPSULATION OF PHASE CHANGE MATERIALS

J. CHEN, R. NELSON, and F. X. POLINSKI In MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev Meeting p 177-184 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

Based on the criteria of high latent heats of fusion, low cost, and ease of pelletization, seven phase change materials (PCM's) with melting points in the ranges suitable for absorption cooling, active heating, and passive space conditioning applications have been pressed into pellets about 12 mm in diameter and then encapsulated with organic coating materials by a roll coating process. Capsules of four of the seven PCM candidates have shown retention of integrity in various aqueous heat exchange fluids in accelerated thermal cycling tests ranging between 1500 to 2900 heating and cooling cycles. Capsules of PCM's melting near room temperature have also shown good stability in laboratory air environment. The objective of this effort is to develop reliable and cost effective PCM's for use in (1) active heat exchange packed bed assemblies of simple design that are capable of providing heat exchange efficiency and storage capacity superior to those of conventional heat storage systems, and (2) passive heat storage systems consisting of building products incorporating thermal energy storage materials. The feasibility of this approach is supported by a favorable cost analysis Author

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N83-25081# Edde (Howard), Inc., Bellevue, Wash.
TES TECHNOLOGY TRANSFER IN THE PULP AND PAPER INDUSTRY

H. EDDE and J. HANDLEY /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev Meeting p 257-261 Feb. 1982

Avail: NTIS HC A17/MF A01

Thermal energy storage (TES) is a technique whereby energy is temporarily stored in order to more uniformly balance steam generation with steam demands. The pulp and paper industry accomplishes this in an accumulator using hot water or steam as the transfer medium. An international study was conducted which showed that TES is presently more universally practiced in Scandinavian mills than in U.S. mills. However, TES offers significant benefits in energy conservation, provides an instant steam reserve to stabilize mill steam demand, prolongs power boiler life, and permits displacement of oil with potentially less expensive and more abundant alternative fuels. The capital pay back time (PBT) is two to three years with return on investment (ROI) of 30 to 50 percent. Projections indicate that installed TES system will become increasingly common in U.S. mills in the near future.

Author

N83-25085# Ko (Kenneth C.) and Associates, Denver, Colo
EFFECTS ON SOILS FROM HOT STORAGE TANKS

K. C. KO /in MCC Associates, Inc. Proc. of the 6th Ann. Thermal and Chem. Storage Contractors' Rev. Meeting p 302-307 Feb. 1982 refs

Avail: NTIS HC A17/MF A01

Behavioral characteristics of foundation soils for hot storage tanks were investigated on two soil models representative of the soils in the Continental U.S. The changes in the engineering properties of the foundation soils due to heating and the effects of four storage media liquids; hydrocarbon oil, silicon oil, molten nitrate salt and liquid sodium into the foundation were investigated. The remedial measures such as soil preconditioning to alleviate the detrimental effects of the heat on soils are presented and the areas for further research are delineated.

E.A.K.

N83-25121# Decision Focus, Inc., Los Altos, Calif.
COMPRESSED-AIR ENERGY STORAGE: COMMERCIALIZATION POTENTIAL AND EPRI ROLES IN THE COMMERCIALIZATION PROCESS Final Report

D. W. BOYD, O. E. BUCKLEY, and C. E. CLARK Dec. 1982 150 p refs

(Contract EPRI PROJ. 1199-15)

(DE83-900987; EPRI-EM-2780) Avail: NTIS HC A07/MF A01

This report describes an assessment of potential roles that EPRI might take to facilitate the commercial acceptance of compressed air energy storage (CAES) systems. The assessment is based on (1) detailed analyses of the market potential of utility storage technologies, (2) interviews with representatives of key participants in the CAES market, and (3) a decision analysis synthesizing much of the information about market and technology status. The results indicate a large potential market for CAES systems if the overall business environment for utilities improves. In addition, it appears that EPRI can have a valuable incremental impact in ensuring that utilities realize the potential of CAES by (1) continuing an aggressive information dissemination and technology transfer program, (2) working to ensure the success of the first United States CAES installation at Soyland Power Cooperative, (3) developing planning methods to allow utilities to evaluate CAES and other storage options more effectively and more realistically, and (4) supporting R and D to resolve residual uncertainties in first-generation CAES cost and performance characteristics.

DOE

N83-25132# California Univ, Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

APPLIED BATTERY AND ELECTROCHEMICAL RESEARCH PROGRAM

F. MCLARNON 1 Jun. 1982 158 p

(Contract DE-AC03-76SF-00098)

(DE82-020600, LBL-14304) Avail: NTIS HC A08/MF A01

Advanced electrochemical systems that satisfy stringent performance and economic requirements for electric vehicle and stationary energy storage applications are discussed. The most promising electrochemical technologies are identified and transferred to industry for further development and scale-up. General problem areas addressed by the program include identification of electrochemical couples for advanced batteries, determination of technical feasibility of couples, improvements in battery components, and establishment of engineering principles applicable to batteries and electrochemical processes. Major emphasis is given to applied research that will lead to superior performance and lower life cycle costs

DOE

N83-25145# Westinghouse Electric Corp, Pittsburgh, Pa. Advanced Energy Systems Div.

DEMONSTRATION OF NEW HIGH-PERFORMANCE BATTERIES IN COAL-MINING SCOOPS Final Technical Report

R. ROSEY Mar. 1982 139 p

(Contract DE-AC01-76ET-12581)

(DE82-020535; DOE/ET-12581/T1) Avail: NTIS HC A07/MF A01

The program objective was to demonstrate the performance features of an improved battery system in underground coal haulage applications that might increase productivity for the equipment and lower operating costs for the mine operator. The program initiated with an investigation of several mine facilities to evaluate the operation of battery powered coal haulers. A design concept and specification for the nickel-iron battery was developed for use in a S and S Corporation CX-2 UNATRAC Coal Hauler An 800 Ah, 132 VDC nickel-iron battery system was assembled and tested. Field tests were conducted at an aboveground test track to simulate actual mining environments. Test results indicated that the nickel-iron battery could provide a range of 40 to 70% additional trips per battery charge cycle. Auxiliary hardware functioned as designed and demonstrated the automatic battery maintenance features. A relatively high number of cell package failures occurred during this test period that precluded an underground demonstration

DOE

N83-25156# Oak Ridge National Lab, Tenn. Engineering Technology Div.

EARTH THERMAL STORAGE FOR ENHANCED PERFORMANCE OF AIR-TO-AIR HEAT PUMPS

M. P. TERNES 1982 13 p Presented at the 17th Intersoc. Energy Conversion Eng. Conf, Los Angeles, 8-13 Aug. 1982

(Contract W-7405-ENG-26)

(DE83-020773, CONF-820814-28) Avail: NTIS HC A02/MF A01

The heat that exists naturally in the earth under a house with a crawl space is used in the winter months to preheat the source air of an air to air heat pump and, thereby, bring about improvements in the efficiency of the heat pump. The source air is warmed by drawing it through the crawl space where it gains heat from the warmer earth. This allows the heat pump to operate in a climate more favorable than ambient. In the past winter, a comprehensive, comparative test of the concept was begun. This test involves three identical unoccupied houses in the Knoxville area, two of which were configured to use the crawl space but in a different manner for each. The third house has a standard heat pump installation and serves as the control for the experiment. The houses were highly instrumented in order to determine the net benefit of the concept. Results from the experiment for the past winter showed that dramatic improvements in the heat pump performance.

DOE

N83-25160# Oak Ridge Y-12 Plant, Tenn.

FLYWHEEL TESTING AND EVALUATION

R. S. STEELE 1982 11 p refs Presented at the Energy Storage Contractors Review Meeting, Arlington, Va., 23-26 Aug. 1982

(Contract W-7405-ENG-26)

(DE82-020894, CONF-820827-7) Avail: NTIS HC A02/MF A01

The state of the art in composite flywheels technology and the supporting data are discussed. Composite flywheel performance is superior to that of metallic flywheels, while presenting less severe containment requirements. Composite flywheel fatigue life exceeds 1000 cycles. Thermal considerations dictate a low pressure environment. Balance characteristics of composite flywheels require special suspension provisions. Analytical models predict performance with increasing confidence and are thus becoming more useful in establishing reliability of the rotor. DOE

N83-25164# Oak Ridge National Lab., Tenn. Engineering Technology Div

OAK RIDGE NATIONAL LABORATORY THERMAL-ENERGY-STORAGE PROGRAM OVERVIEW

J. F. MARTIN 1982 11 p Presented at the Energy Storage Contractors Rev. Meeting, Arlington, Va., 23 Aug. 1982

(Contract W-7405-ENG-26)

(DE82-020818, CONF-820827-17) Avail: NTIS HC A02/MF A01

Thermal energy storage technology development for building heating and cooling and industrial applications was reviewed. The program of technical assessment and research and development is carried out in support of the national objective of energy conservation and development of new energy sources. The activities supported by this program are described. DOE

N83-25201# Sargent and Lundy, Engineers, Chicago, Ill.

COMPRESSED-AIR ENERGY-STORAGE PRELIMINARY DESIGN AND SITE-DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 9: COST ESTIMATE AND SCHEDULE Final Report

Dec. 1982 120 p refs

(Contract DE-AC02-78ET-29232; EPRI PROJ 1081-3)

(DE83-005727, EPRI-EM-2351-VOL-9) Avail: NTIS HC A06/MF A01

The behavior and suitability of aquifers as compressed-air energy-storage sites is discussed. The engineering and construction schedule, facilities capital-cost estimate, and corresponding cash-flow requirements are given. DOE

N83-26264# EIC, Inc., Newton, Mass.

EXPLORATION OF THE FEASIBILITY OF PRESENT GENERATION LITHIUM BATTERIES FOR ELECTRIC VEHICLES

P. B. HARRIS, G. L. HOLLECK, J. BUZBY, J. AVERY, and L. PITTS Nov. 1982 54 p

(Contract N00014-77-C-0155)

(AD-A124098; C-480A; TR-9) Avail: NTIS HC A04/MF A01

CSCL 10C

The technology of secondary Li batteries was investigated for feasibility for use in automotive propulsion systems. A computer modeling effort examined series vs. parallel plate arrangement in battery modules and critical factors limiting energy density in each case. It was found that the most critical factor is the cathode energy density, and that to achieve the ultimate goal of 125 Wh/lb a cathode energy density of 290 Wh/lb is necessary. The 20 Ah Li/LiAsF₆ in 2Me-THF MoS₃ cells were built and tested. Although MoS₃ is theoretically capable of providing the necessary energy density to meet the ultimate goal, it requires more development to overcome chemical instability in the system. GRA

N83-26267# Daimler-Benz A. G., Stuttgart (West Germany)

STATIONARY HYDRIDE STORAGE SYSTEMS AS EQUALIZING SYSTEMS FOR ELECTRICAL PEAK LOADS Final Report

H. BUCHNER, E. SCHMIDT-IHN, E. KLIEM, U. LANG, and U. SCHEER 1982 142 p refs Transl. into ENGLISH of the mono "Stationare Hydridspeicher als Ausgleichsspeicher Elektrischer Spitzenenergien" West Germany, 1981 168 p (PB83-149666) Avail: NTIS HC A07/MF A01 CSCL 10C

The storage of electric peak energy by means of hydrogen has been investigated from a technical and economic point of view for a stationary hydride storage system with a capacity of 100-1,000 MWh (32,000-320,000 cu m H₂). Titanium, chromium, and manganese-based low-temperature hydrides which store 2 percent of hydrogen were chosen and their thermodynamic and kinetic properties as well as their thermal conductivity were examined. The low thermal conductivity of the material is improved by the admixture of metal powder. An operational cycle of 8 hours each of absorption, storage and deep desorption was assumed, heat flow being the rate limiting factor. Two variants (steels or concrete outer jacket) are described. Depending on its size, the hydride storage system consists of 2 to 20 storage units with a H₂ capacity of 16000 cu m each. Author (GRA)

N83-26268# Argonne National Lab., Ill

ENERGY STORAGE CRITERIA HANDBOOK Final Report, Mar. 1981 - Jun. 1982

J. R. HULL, R. L. COLE, and A. B. HULL Oct. 1982 485 p refs

(Contract N68305-81-MP-10027)

(AD-A125180; NCEL-CR-82.034) Avail: NTIS HC A21/MF A01 CSCL 10C

The purpose of this handbook is to provide information and criteria necessary for the selection and sizing of energy storage technologies for use at U.S. Naval facilities. The handbook gives Naval base personnel procedures and information to select the most viable energy storage options to provide the space conditioning (heating and cooling) and domestic hot water needs of their facility. The handbook may also be used by contractors, installers, designers, engineers, architects, and manufacturers who intend to enter the energy storage business. The handbook is organized into three major sections: a general section, a technical section, and an example section. While a technical background is assumed for the latter two sections, the general section is simply written and can serve as an introduction to the field of energy storage. The technical section examines the following energy storage technologies: sensible heat storage, latent heat storage, cold storage, thermochemical storage, mechanical storage, pumped hydro storage, and electrochemical storage. The example section is limited to thermal storage and includes examples for: water tank storage, rockbed storage, latent heat storage, and cold water storage. GRA

N83-26291# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst., Golden, Colo.

THERMOCHEMICAL ENERGY STORAGE AND TRANSPORT

R. G. NIX Aug. 1982 6 p refs Presented at the Energy Storage Contractors Review Meeting, Arlington, Va., 23-27 Aug. 1982

(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE82-020069; SERI/TP-234-1681; CONF-820827-3) Avail: NTIS HC A02/MF A01

Thermochemical energy storage and transport (TEST) were studied. Cases studied include a large central receiver heat utility and a small industrial process heat application with distributed parabolic dish solar collectors. The TEST does not appear to be generally cost effective; however, there are special cases of cost effectiveness. It is recommended that research on thermochemical processes emphasize the manufacture of renewable fuels using solar energy and the search for more cost effective TEST systems. DOE

07 ENERGY STORAGE

N83-26296# United Technologies Corp., East Hartford, Conn
EVALUATION OF INDUSTRIAL ADVANCED HEAT-RECOVERY/THERMAL-ENERGY-STORAGE SYSTEMS, VOLUME 2 Final Report

H. R. MCCHESENEY, R. W. BASS, A. M. LANDERMAN, T. N. OBEE, and C. T. SGAMBOTI Dec 1982 438 p refs Sponsored by EPRI

(Contract EPRI PROJ. 1275-1)

(DE83-901132, EPRI-EM-2573-VOL-2) Avail: NTIS HC A19/MF A01

The recovery of waste heat from industrial processes offers significant opportunity for energy conservation provided the available energy source can be matched with a compatible energy consuming sink or end-use process. This investigation involved examining plant and process energy data acquired during on-site visits to 12 industrial plants from which 24 candidate applications were identified where thermal energy storage would be necessary either to make possible or to enhance the recovery and reuse of industrial waste energy; compiling cost and performance data for commercially available equipment to recover, store and transfer waste heat between source and sink processes on demand, and assessing the economic benefits, possible energy savings and utility impact if proposed systems were installed and operated in industrial plants. Detailed industrial process data, pertinent equipment technical and cost information, proposed plant advanced heat recovery/thermal energy storage system designs, and a complete discussion of the procedures used and the results obtained are presented. DOE

N83-26306# Exxon Research and Engineering Co., Linden, N.J.
Advanced Energy Systems Labs
DEVELOPMENT OF A CIRCULATION ZINC-BROMINE BATTERY, PHASE 1

R. BELLOWS, H. EINSTEIN, P. GRIMES, E. KANTNER, P. MALACHESKY, K. NEWBY, and H. TSIEN Jan. 1983 185 p refs

(Contract DE-AC04-76DP-00789)

(DE83-006841; SAND-82-7022) Avail: NTIS HC A09/MF A01

A three phase program aimed at developing a circulating zinc bromine battery for photovoltaic energy storage is summarized. This approach incorporates carbon plastic electrodes in a bipolar stack design, a circulating electrolyte with separable bromine complexes, and shunt current protection are incorporated. Successful scale up and demonstration of 3 and 10 kWh submodules were completed. Two smaller demonstration batteries were for testing. Important technology improvements were demonstrated concerning shunt current protection, improved performance of low cost microporous separators, and insert injection molding of electrodes and separators. Ease technology was expanded via an increased parametric testing program, materials testing and electrolyte studies. Production cost estimates were revised based on improved design concepts to project direct factory costs for large scale production of 20 kWh modules. A potential developmental was drafted, delineating critical development milestones. The project effort is continuing to show steady progress toward developing a deliverable 20 kWh photovoltaic battery. DOE

N83-26930# California Univ., Livermore Lawrence Livermore Lab.

NONDESTRUCTIVE INSPECTION AND EVALUATION OF COMPOSITE-MATERIAL FLYWHEELS

K. L. REIFSNIDER, D. M. BOYD, and S. V. KULKARNI 24 Feb. 1982 32 p refs 2 Vol.

(Contract W-7405-ENG-48)

(DE82-015379; UCRL-53264-VOL-2) Avail: NTIS HC A03/MF A01

Flywheels made from composite materials are capable of storing energy with a significantly higher energy density than those made from conventional metals. Since composite materials are also very durable and inherently safer for such applications, it appears that they will play a major role in flywheel energy storage systems. Flywheels made from composite materials are inspected with

nondestructive test methods to establish their initial quality and their subsequent integrity during service. A variety of methods is discussed in the context of special requirements for the examination of composite flywheel structures and the results of several example nondestructive evaluations before and after spin testing are presented. Recommendations for general nondestructive testing and evaluation of composite material flywheels are made. DOE

N83-26931# California Univ., Livermore. Lawrence Livermore Lab.

POTENTIAL OF COMPOSITE MATERIALS IN SURFACE TRANSPORTATION APPLICATIONS

S. V. KULKARNI 16 Dec 1982 49 p

(Contract W-7405-ENG-48)

(DE83-007218, UCRL-53351) Avail: NTIS HC A03/MF A01

The different issues associated with materials substitution with fiber reinforced composites in surface transportation vehicles were addressed and pertinent high risk R and D areas having payoff in the far term were identified. Initially, a brief summary of the various materials and processes, and prototype development programs is presented. Subsequently, factors inhibiting the use of composites are listed and finally, future R and D areas are delineated. No attempt was made to perform an exhaustive study and cover every aspect and activity in this technology area. This is due primarily to the limited scope of this effort and to the vastness of the field. DOE

N83-27061# Delaware Univ., Newark. Inst. of Energy Conversion.

PHASE-CHANGE MATERIALS IN MASONRY CONSTRUCTION Final Report

M. LANG Jan. 1982 136 p refs

(Contract DE-FC02-80CS-30586)

(DE83-007227; DOE/CS/30586-1) Avail: NTIS HC A07/MF A01

A demonstration project leading to commercialization of a passive thermal wall using phase change storage materials (PCM) in masonry construction is reported. Techniques of vacuum forming have been identified and characterized making it possible to produce high-volume low-cost packages for insertion into the core of cement blocks. PCM filled packages with aluminum laminated film produces a long life product capable of operating to store and release solar heat over long periods of time. Accelerated tests indicate operability over the life of the building. Five hundred accelerated test cycles have shown insignificant deterioration of capacity of the phase change material. The testing program shows that the wall is capable of both storing and transmitting heat in a similar manner to conventional trombe walls, but with increased thermal capability. Product cost data on return on investment estimates are low enough to be economically attractive. DOE

N83-27351*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. CYCLE LIFE TEST Annual Report

J. D. HARKNESS 22 Feb. 1982 298 p

(Contract NASA ORDER C-13105-D)

(NASA-CR-172679, NAS 1.26.172679; WQEC/C-82-23; AR-18)

Avail: NTIS HC A13/MF A01 CSCL 10C

Evaluation of secondary spacecraft cells was begun according to the program outline. The cycle life test of the evaluation program of secondary spacecraft cells, through 15 December 1981 is covered. Author

N83-27352*# Naval Weapons Support Center, Crane, Ind
Weapons Quality Engineering Center.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. CYCLE LIFE TEST Annual report
J. D. HARKNESS 1983 300 p
(Contract NASA ORDER C-13105-D)
(NASA-CR-172680; NAS 1.26:172680, WQEC/C-83-1; AR-19)
Avail: NTIS HC A13/MF A01 CSCL 10C

Evaluation of secondary spacecraft was begun. The cycle life test of the evaluation program of secondary spacecraft cells, through 15 December 1982 is covered. Author

N83-27382# Pacific Northwest Lab., Richland, Wash.
AQUIFER THERMAL-ENERGY-STORAGE COSTS WITH A SEASONAL-CHILL SOURCE
D. R. BROWN Jan. 1983 65 p refs
(Contract DE-AC06-76RL-01830)
(DE83-006700; PNL-4587) Avail: NTIS HC A04/MF A01

The cost of energy supplied by an aquifer thermal energy storage (ATES) system from a seasonal chill source was investigated. Costs were estimated for point demand and residential development ATES systems using the computer code AQUASTOR. AQUASTOR was developed at PNL specifically for the economic analysis of ATES systems. In this analysis the cost effect of varying a wide range of technical and economic parameters was examined. Those parameters exhibiting a substantial influence on the costs of ATES delivered chill were: system size, well flow rate; transmission distance, source temperature; well depth, and cost of capital. The effects of each parameter are discussed. Two primary constraints of ATES chill systems are the extremely low energy density of the storage fluid and the prohibitive costs of lengthy pipelines for delivering chill to residential users. This economic analysis concludes that ATES-delivered chill will not be competitive for residential cooling applications. The otherwise marginal attractiveness of ATES chill systems vanishes under the extremely low load factors characteristic of residential cooling systems (LCL) DOE

N83-27465# Pacific Northwest Lab., Richland, Wash.
GEOTECHNICAL FACTORS AND GUIDELINES FOR STORAGE OF COMPRESSED AIR IN SOLUTION-MINED SALT CAVITIES
R. D. ALLEN, T. J. DOHERTY, and R. L. THOMS May 1982 106 p refs
(Contract DE-AC06-76RL-01830)
(DE82-017611; PNL-4242) Avail: NTIS HC A06/MF A01

The state of knowledge about utilization of solution mined salt cavities for CAES including laboratory experiments, numerical modeling, field characterization, solution mining experience, and operating parameters is outlined. Topics evaluated include: cavern geometry and size; long term creep and creep rupture of rock salt, effects of pressure and temperature loading rates, low frequency fatigue, progressive deterioration of salt fabric with possible air penetration; cavern monitoring methods; and salt properties at nonambient conditions. The only CAES operational facility in the world uses two solution mined salt cavern for air storage and is operating successfully. Stability criteria for solution mined salt caverns. DOE

N83-27631# Pacific Northwest Lab., Richland, Wash.
USER MANUAL AQUASTOR: A COMPUTER MODEL FOR COST ANALYSIS OF AQUIFER THERMAL-ENERGY STORAGE COUPLED WITH DISTRICT HEATING OR COOLING SYSTEMS. VOLUME 2: APPENDICES
H. D. HUBER, D. R. BROWN, and R. W. REILLY Apr. 1982 170 p 2 Vol.
(Contract DE-AC06-76RL-01830)
(DE82-013889, PNL-4236-Vol-2) Avail: NTIS HC A08/MF A01

A computer model called AQUASTOR was developed for calculating the cost of district heating (cooling) using thermal energy supplied by an aquifer thermal energy storage (ATES) system, the AQUASTOR Model can simulate ATES district heating systems using stored hot water or ATES district cooling systems using stored chilled water. AQUASTOR simulates the complete ATES district

heating (cooling) system, which consists of two principal parts. the ATES supply system and the district heating (cooling) distribution system. The supply system submodel calculates the life-cycle cost of thermal energy supplied to the distribution system by simulating the technical design and cash flows for the exploration, development, and operation of the ATES supply system. The distribution system submodel calculates the life-cycle cost of heat (chill) delivered by the distribution system to the end-users by simulating the technical design and cash flows for the construction and operation of the distribution system. DOE

N83-28359 Florida Univ., Gainesville.
INVESTIGATION OF A LOW HEAT LOSS HIGH TEMPERATURE THERMAL ENERGY STORAGE SYSTEM Ph.D. Thesis
N. A. COPE 1982 163 p
Avail: Univ. Microfilms Order No DA8226380

A low heat loss thermal energy storage system capable of storage in a range of 250-100 F is described. The design criteria called for a storage system that is simple to construct, uses inexpensive and readily available materials, utilizes an insulating material with a thermal conductivity between 0.003 - 0.015 Btu/hr-ft F for temperatures ranging between 250-100 F, and be suitable for residential or commercial applications. A design selected to fulfill the above criteria consists of a double tank wherein the annular space between the tanks is filled with a porous powder (silica) and then evacuated to a pressure of approximately 1 mm Hg. Thermal conductivity values of 0.0029 - 0.1100 Btu/hr-ft F were achieved experimentally for vacuum levels ranging from 0.5 - 3.0 mm Hg and hot surface temperatures ranging from 340 - 711 F. Dissert. Abstr

N83-28586# Courtesy Associates, Inc., Washington, D.C.
PROCEEDINGS OF THE DOE PHYSICAL AND CHEMICAL ENERGY STORAGE ANNUAL CONTRACTORS' REVIEW MEETING
Dec. 1982 592 p refs Meeting held in Arlington, Va., 23-26 Aug. 1982
(Contract DE-AC02-76CH-00016)
(DE83-004756; CONF-820827) Avail: NTIS HC A25/MF A01

The goals and accomplishments of energy systems and storage projects are described. The specific technology areas include chemical/hydrogen energy systems, underground energy storage, superconducting magnetic energy storage, mechanical energy storage, solar thermal energy storage, and thermal energy storage for building heating and cooling and industrial applications.

N83-28609# Louisiana State Univ., Baton Rouge Inst. for Environmental Studies.
SALT STUDIES: CONCLUSIONS
R. L. THOMS and R. M. GEHLE In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 153-157 Dec. 1982 refs
Avail: NTIS HC A25/MF A01

This report represents the conclusion of the compressed air energy storage (CAES) program in salt. It includes a brief background of salt cavity studies and utilization for CAES, the focuses on long-term stability criteria for solution mined salt cavities. Summary statements are made on some of the more important criteria and their significance for operational peaking-power plants utilizing salt cavities for CAES reservoirs. The concluding section of this report incorporates a discussion of the future for CAES in U.S. salt deposits. This discussion is based mainly on technical considerations, since they have been the main consideration in this particular study. Obviously, economic analyses will dominate decisions by utilities on construction schedules for any technically feasible CAES study. Author

07 ENERGY STORAGE

N83-28612# Fluidyne Engineering Corp., Minneapolis, Minn. **THERMAL ENERGY STORAGE MEDIA FOR ADVANCED COMPRESSED AIR ENERGY STORAGE SYSTEMS**

L. MARKSBERRY /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 177-186 Dec. 1982 refs Sponsored in part by EPRI
Avail. NTIS HC A25/MF A01

Screening tests were performed to compare materials for thermal energy storage pebble media in advanced compressed air energy storage power plants. The effects of thermal cycling and bed weight on pebble deterioration were measured. Four materials were tested: Denstone fireclay, iron ore, basalt rock, and cast iron. Each was tested as a pebble bed 0.9 m (3 ft) in diameter and 4.6 m (15 ft) high. The beds were heated and cooled between 310 K (100 F) and 750 K (900 F) for four hours per cycle. The most significant result was the good performance of the basalt rock, which is also the lowest cost material by margin.

Author

N83-28613# Argonne National Lab., Ill. **TECHNICAL AND ECONOMIC ANALYSIS OF ENERGY STORAGE**

J. G. ASBURY, R. F. GIESE, R. MUELLER, A. VALENTINO, and W. WALSH /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 187-191 Dec. 1982 refs

Avail: NTIS HC A25/MF A01

The performance and cost of chilled water and ice storage systems in commercial buildings applications was evaluated. Paybacks of less than four years were estimated under rate schedules currently in force in many parts of the country. Three concepts for energy storage and transport that merit consideration for research and development support were identified: multicomponent slurries for enhanced heat transfer, transport, and storage; superconducting magnetic energy storage for fusion reactor applications; and polymer materials for thermal storage (especially seasonal) applications.

Author

N83-28614# Los Alamos Scientific Lab., N. Mex. **THE 30 MJ SUPERCONDUCTING MAGNETIC ENERGY STORAGE FOR BPA TRANSMISSION LINE STABILIZER**

J. D. ROGERS /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 193-196 Dec. 1982 refs

Avail. NTIS HC A25/MF A01

The stability of the Western U.S. Power System is affected by the relative weakness of the electric transmission system connecting the Pacific Northwest and southern California. A 30 MJ (8.4 kWh) superconducting magnetic energy storage unit with a 10 MW converter to provide system damping for low frequency oscillations is being installed to provide system damping for low frequency oscillations. The seismic mounting of the 30 MJ coil to the dewar lid is complete. Computer operation of the heat rejection trailer, high pressure gas recovery trailer, and converter is accomplished. The converter was operated with an inductive load with energy discharge through the protective dump circuit. Partial computer operation of the refrigerator was performed. The nonconducting dewar was built and tested.

A.R.H.

N83-28616# Oak Ridge National Lab., Tenn. **FLYWHEEL TESTING AND EVALUATION**

R. S. STEELE /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 220-229 Dec. 1982 refs

(Contract W-7405-ENG-26)

Avail: NTIS HC A25/MF A01

Results of spin tests support early predictions of flywheel performance, but real world factors require further investigation. Data are presented to support the following general statements: (1) composite flywheel performance is superior to that of metallic flywheels, while (2) presenting less severe containment requirements; (3) composite flywheel fatigue life exceeds 1000 cycles; (4) thermal considerations dictate a low pressure

environment; (5) balance characteristics of composite flywheels require special suspension systems provisions; and (6) analytical models predict performance with increasing confidence and are thus becoming more useful in establishing the reliability of the rotor. Testing efforts must now address questions relating to lifetime, reliability, system design, and cost.

A.R.H.

N83-28617# Battelle Columbus Labs., Ohio. **MANUFACTURING COST/DESIGN TRADE-STUDIES FOR FLYWHEEL**

B. R. NOTON /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 230-239 Dec. 1982 refs

Avail: NTIS HC A25/MF A01

A procedure is described for enabling comparison of different flywheel designs based on both performance ratings, and manufacturing and inspection cost. Development of the methodology requires identification of all the steps in the manufacture and inspection of each design, the cost drivers, and the ground rules. A man-hour summary must also be provided. The approach to determine the recurring and nonrecurring manufacturing man-hours is presented. Cost drivers in composite manufacture are discussed as well as the approach to address cost driver data from industry. Some indications for cost driver data from industry. Some indications for cost reduction are included.

A.R.H.

N83-28619# California Univ., Livermore. Lawrence Livermore Lab. **FIBER COMPOSITE MATERIALS TECHNOLOGY FOR FLYWHEEL ENERGY STORAGE**

T. T. CHIAO and R. L. MOORE /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 250-254 Dec. 1982

Avail: NTIS HC A25/MF A01

Of four fibers developed, two show promise for flywheel applications. One is an improved organic which is not yet commercially available, the other is a graphite tow which is in pilot production. Preliminary strength properties are summarized for 1140 denier strands of the organic and 6K filament tow of graphite impregnated with an epoxy. Design data are given for an S-2 glass-epoxy composite and the longitudinal tension properties of this composite are shown in a table.

A.R.H.

N83-28621# Aerospace Corp., El Segundo, Calif. **ASSESSMENT OF FLYWHEEL SYSTEM BENEFITS IN SELECTED VEHICLE APPLICATIONS**

L. FORREST /In Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 263-269 Dec. 1982

Avail: NTIS HC A25/MF A01

Flywheel-equipped vehicles were compared with their non-flywheel counterparts (baseline systems) on the basis of energy utilization. To accomplish this, a computer-based vehicle simulation program was developed. This program determines the propulsion power required to negotiate each element of the driving cycle, and apportions this power between prime mover and storage device according to one or more selected operating strategies. The state of flywheel (and/or battery) charge is continuously tracked, along with the consumption of fuel or dissipation of battery energy. Energy flows associated with all major component processes are accounted for. Results are given for a four-passenger commuter vehicle with electric drive (range extension application of the flywheel system) and a six-passenger family car with conventional heat engine drive (fuel conservation application of the flywheel system). The six-passenger vehicle was also examined with respect to its use in urban taxi service.

A.R.H.

N83-28624# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

DIRECT-CONTACT THERMAL STORAGE RESEARCH

J. D. WRIGHT and M. S. BOHN /in Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 312-318 Dec 1982 refs
 Avail: NTIS HC A25/MF A01

Direct contact thermal storage research is studied in order to reduce the heat transfer related costs of thermal energy storage systems by performing research on direct contact heat transfer. Research is presently focused on direct contact between air and molten nitrate salts. These devices have cost advantages over conventional fin tube indirect heat exchangers and would be used to couple short term molten salt storage to longer term air/rock storage to obtain long duration storage. These devices would also be used in very high temperature systems that employ molten carbonates or sodium hydroxide. An experimental loop is being constructed to develop and to test methods for predicting the performance of such devices, and to test packing designs. Work using direct contact heat exchange on low temperature latent heat storage in salt hydrates was concluded. Heat transfer was adequate, but some practical operation problems remained. S.L.

N83-28630# Institute of Gas Technology, Chicago, Ill
DEVELOPMENT OF COMPOSITE TES MEDIA FOR HIGH-TEMPERATURE STORAGE APPLICATIONS

T. D. CLAAR, R. J. PETRI, and E. T. ONG /in Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev Meeting p 426-432 Dec. 1982 refs
 Avail: NTIS HC A25/MF A01

A thermal energy storage (TES) media concept utilizing carbonate salts retained within the microporous structure of a ceramic matrix is being developed for such high temperature storage applications as industrial waste heat recovery/storage and solar thermal power systems. The composite carbonate salt/ceramic media can operate in direct contact with compatible working fluids, a feature which offers significant potential for cost reduction and improved heat exchange performance over previous shell and tube molten salt TES designs. Results of the generic composite media development efforts, materials stability testing, and TES performance evaluations are discussed. S.L.

N83-28631# Rocket Research Corp., Redmond, Wash.
APPLICATION OF THERMAL ENERGY STORAGE TO PROCESS HEAT RECOVERY. PHASE 3: HEAT EXCHANGER TESTING IN DIRTY GAS ENVIRONMENT

L. B. KATTER and D. J. SHAW /in Courtesy Assoc., Inc. Proc. of the DOE Phys. and Chem. Storage Ann. Contractors' Rev. Meeting p 433-440 Dec. 1982
 Avail: NTIS HC A25/MF A01

The use of thermal energy storage to improve the utilization of reject process heat as a source of energy for a district heating system is investigated. The specific energy source being studied is the aluminum reduction process. Energy supply in an aluminum plant is continuous and constant 24 hours/day, 365 days/year. The energy demand in a district heating system is highly variable with diurnal, weekly and annual cycles. Thermal energy storage improves the cost effectiveness of investments in energy recovery and distribution equipment and decreases the need for supplemental fuel for the district heating system. S.L.

N83-28682# Gould, Inc., Rolling Meadows, Ill.
MAINTENANCE-FREE, DEEP-DISCHARGE, LEAD-ACID BATTERY FOR PHOTOVOLTAIC APPLICATIONS

J. SZYMBORSKI Apr. 1982 99 p refs
 (Contract DE-AC04-76DP-00789)
 (DE82-014614; SAND-82-7026) Avail: NTIS HC A05/MF A01

Progress in the development, design, fabrication, and testing of totally maintenance-free sealed lead-acid batteries suitable for the deep-discharge regimes of solar photovoltaic applications is reported. The 6-volt, 100-ampere-hour battery was designed to meet these additional key design goals: 6-h nominal discharge rates; 80% depth-of-discharge daily duty cycle; 2000 cycles to an

80% depth-of-discharge, recharge in less than 8 h; 80% roundtrip energy efficiency; and self-discharge rate of less than 1% per week. Totally maintenance-free sealed operation was achieved by designing the cells so that only oxygen is generated on charge. The cells in this battery are fabricated with positive grids cast from a low antimony alloy in order to achieve both maintenance-free operation and good deep cycle performance. Various cycle life tests and tests to determine the tolerance of the battery to operation and storage at various states-of-charge and over a wide range of temperatures were performed. The charging parameters to adequately recharge the battery while minimizing overcharge and gassing were extensively studied. DOE

N83-28712# Pacific Northwest Lab., Richland, Wash.
THERMODYNAMIC ANALYSIS OF FIVE COMPRESSED-AIR ENERGY-STORAGE CYCLES

J. A. FORT Mar. 1983 50 p refs
 (Contract DE-AC06-76RL-01830)
 (DE83-009470; PNL-4639) Avail: NTIS HC A03/MF A01

One important aspect of the compressed air energy storage (CAES) program is the evaluation of alternative CAES plant designs. The thermodynamic performance of the various configurations is critical to the successful demonstration of CAES as an economically feasible energy storage option. A computer code, the compressed air energy storage cycle analysis program (CAESCAP), was developed. This code was designed to calculate overall thermodynamic performance of proposed CAES system configurations. The results of applying this code to the analysis of five CAES plant designs are presented. The designs analyzed are conventional CAES; adiabatic CAES; hybrid CAES, pressurized fluidized bed CAES; and direct coupled steam CAES. Data were used to diagram the availability and energy flow for each of the five cycles. The resulting diagrams graphically illustrate the overall thermodynamic performance inherent in each plant configuration, and enable a more accurate and complete understanding of each design. DOE

N83-29827# Oak Ridge National Lab., Tenn. Engineering Technology Div.

FIXED-BASE FLYWHEEL STORAGE SYSTEMS FOR ELECTRIC-UTILITY APPLICATIONS: AN ASSESSMENT OF ECONOMIC VIABILITY AND R AND D PRIORITIES

M. OLSZEWSKI and R. S. STEELE Feb. 1983 45 p refs
 (Contract W-7405-ENG-26)
 (DE83-007171; ORNL/TM-8391) Avail: NTIS HC A03/MF A01

Electric utility side meter storage options were assessed for the daily 2 h peaking spike application. The storage options considered included compressed air, batteries, and flywheels. The potential role for flywheels in this application was assessed and research and development (R and D) priorities were established for fixed base flywheel systems. Results of the worth cost analysis indicate that where geologic conditions are favorable, compressed air energy storage (CAES) is a strong competitor against combustion turbines. Existing battery and flywheel systems rated about equal, both being, at best, marginally uncompetitive with turbines. Advanced batteries, if existing cost and performance goals are met, could be competitive with CAES. A three task R and D effort for flywheel development appears warranted. The first task, directed at reducing fabrication costs and increasing performance of a chopped fiber, F-glass, solid disk concept, could produce a competitive flywheel system. DOE

N83-29859# Battelle Pacific Northwest Labs., Richland, Wash.
AN ASSESSMENT OF SECOND-GENERATION COMPRESSED-AIR ENERGY-STORAGE CONCEPTS

F. R. ZALOUDEK and R. W. REILLY Jul 1982 85 p refs
 (Contract DE-AC06-76RL-01830)
 (DE82-019513; PNL-3978) Avail: NTIS HC A05/MF A01

The Pacific Northwest Laboratory (PNL) conducted an assessment of the adiabatic compressed air energy storage (CAES), hybrid CAES, CAES with coal gasification, and CAES with pressurized fluidized bed combustion concepts based on information provided in conceptual design studies. The PNL

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assessment covered consideration of the technological readiness, relative economic benefits, and operational viability of each concept. It was concluded that the adiabatic CAES concept appears to be the most attractive candidate for utility application in the near future. It is operationally viable, economically attractive compared with competing concepts, and will require relatively little additional development before plant construction can be undertaken. It was estimated that a utility could start the design of a demonstration plant in 2 to 3 years if research regarding thermal energy storage system design is undertaken in a timely manner. DOE

N83-29862# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Lab.

PRESENT DEVELOPMENT STATUS OF EXXON'S ZINC-BROMINE BATTERY FOR BULK ENERGY STORAGE

R. BELLOW and P. MALACHESKY 6 May 1982 22 p Presented at the DUG-U BOAT Joint Meeting, Miami, Fla., 6 May 1982

(Contract DE-AC04-76DP-00789)

(DE82-013642; SAND-82-7044C; CONF-820542-1) Avail. NTIS HC A02/MF A01

Portions of document are illegible. Diagrams and slide reproductions of the system are presented; and performance, maintenance, and cost information is outlined. DOE

N83-29865# Avco Systems Div., Wilmington, Mass.

A COMPOSITE-FLYWHEEL BURST-CONTAINMENT STUDY

A. D. SAPOWITH and W. E. HANDY Jan. 1982 120 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.

(Contract W-7405-ENG-48)

(DE82-014138; UCRL-15452; AVSD-0350-81-RR) Avail. NTIS HC A06/MF A01

A key component impacting total flywheel energy storage system weight is the containment structure. This report addresses the factors that shape this structure and define its design criteria. In addition, containment weight estimates are made for the several composite flywheel designs of interest so that judgements can be made as to the relative weights of their containment structure. The requirements set down for this program were that all containment weight estimates be based on a 1 kWh burst. It should be noted that typical flywheel requirements for regenerative braking of small automobiles call for deliverable energies of 0.25 kWh. This leads to expected maximum burst energies of 0.5 kWh. The flywheels studied are those considered most likely to be carried further for operational design. These are: The pseudo isotropic disk flywheel, sometimes called the alpha ply, the SMC molded disk; either disk with a carbon ring; the subcircular rim with cruciform hub; and Avco's bi-directional circular weave disk. DOE

08

GENERAL

A83-33641

EFFECT OF PROCESSING ON FATIGUE LIFE OF Ti-6Al-4V CASTINGS

F. C. TEIFKE, N. H. MARSHALL (Tilene, Inc., Albany, OR), D. EYLON (Metcut-Materials Research Group, Wright-Patterson AFB, OH), and F. H. FROES (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN: Advanced processing methods for titanium, Proceedings of the Symposium, Louisville, KY, October 13-15, 1981. Warrendale, PA, Metallurgical Society of AIME, 1982, p. 147-159. refs

(Contract F33615-79-C-5152)

When the properties of such cast Ti alloys as Ti-6Al-4V are compared with those of comparable wrought materials, the greatest deficiency noted is a poor high cycle fatigue strength, due both to casting defects and the inherent microstructural properties of a casting, which contribute to early fatigue crack initiation. It is

presently shown that this problem can be partially corrected by means of Hot Isostatic Pressing (HIP), which closes the pores imparted during the casting operation. Even after HIP, however, the fatigue strength of castings is lower than that of wrought products. O.C.

A83-39859

EXPERIMENTAL INVESTIGATION OF ABSORPTION COEFFICIENT OF CESIUM RESONANCE DOUBLET IN A PLASMA OF COMBUSTION PRODUCTS

I. A. VASILEVA, L. V. DEPUTATOVA, and A. P. NEFEDOV (Akademii Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) (Teplofizika Vysokikh Temperatur, vol. 20, Nov.-Dec 1982, p. 1032-1037) High Temperature (ISSN 0018-151X), vol. 20, no. 6, May 1983, p. 809-814. Translation refs

N83-23915# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY AND TECHNOLOGY REVIEW

I. F. STOWERS Sep. 1982 44 p

(Contract W-7405-ENG-48)

(DE83-000340; UCRL-52000-82-9) Avail. NTIS HC A03/MF A01

The early history of the Lawrence Livermore national laboratory is reviewed, including: the LLNL-Nevada organization; project Plowshare; the chemistry and materials science department; and development of computer systems. DOE

N83-24687# Telic Corp., Santa Monica, Calif.

INVESTIGATION OF CONTINUOUS DEPOSITION OF AMA-TYPE COATINGS ONTO STRIP AND SHEET BY SPUTTERING Final Report, 5 Sep. 1980 - 31 May 1982

J. A. THORNTON and J. L. LAMB 15 Dec. 1982 86 p refs

(Contract DE-AC04-80AL-13116)

(DE83-005692; TELIC-82-3) Avail. NTIS HC A05/MF A01

The continuous deposition of Al₂O₃-Mo-Al₂O₃ coatings onto copper and aluminum foil strip was investigated. High rate Al₂O₃ reactive sputtering experiments are described. The continuous deposition of AMA coatings at reasonable production volumes requires Al₂O₃ deposition rates which can only be achieved with reactive sputtering targets operating in the non-oxidized or non-poisoned mode. The Al₂O₃ reactive sputtering from non-poisoned targets, with deposition rates approaching the range required for continuous deposition onto strip (2.5 to 3.3 nm/s), was demonstrated. Particular attention was given to the problems of gas phase isolation between adjacent processing stations. The continuous deposition studies were conducted with the Al₂O₃ reactive sputtering sources operating in the poisoned state. Short sections of strip were successfully coated. Problems of substrate heating precluded sustained operation in the continuous deposition mode. DOE

N83-25046# Argonne National Lab., Ill. Energy and Environment Systems Div.

COMMUNITY ENERGY MANAGEMENT: AN ANNOTATED BIBLIOGRAPHY

M. J. MESHENBERG Apr. 1982 98 p

(Contract W-31-109-ENG-38)

(ANL/CNSV-29) Avail. NTIS HC A05/MF A01

Community plans and studies, background readings in community energy management, and methods and procedures are discussed. Author

N83-25056# Department of Energy, Washington, D. C.

AN ASSESSMENT OF THE BASIC ENERGY SCIENCE PROGRAM. VOLUME 1: TECHNICAL REPORT

Mar. 1982 56 p 2 Vol.

(DOE/ER-0123) Avail. NTIS HC A04/MF A01

An assessment was undertaken of basic energy sciences (BES) program. A randomly selected sample of 129 projects was reviewed by panels of scientific peers. The reviews were conducted by 40 separate panels with an average of four members per panel. The panels rated individual projects on the basis of quality of science,

quality of the project team, and probable impact on the mission. All of the ratings in the assessment were on a scale of 0 to 10. For each rating variable, a set of descriptors was provided which defined intervals on the scale. In all cases, the descriptors for 5 to 10 had the sense of project quality ranging from acceptable to outstanding; and descriptors below 5 had the sense of a project having serious deficiencies. These ratings were used to make statistical inferences concerning the BES program. There was substantial uniformity in the judgments of the panel members. The mean of the standard deviations of panel members' ratings of individual projects was less than 1.0 (on the scale of 0-10) for the 129 projects reviewed. S.L.

N83-27218# Massachusetts Inst. of Tech., Cambridge.
WELDING TECHNOLOGIES AND MATERIALS FOR ENERGY APPLICATIONS IN JAPAN
 I. MASUMOTO (Nagoya Univ.), K. MASUBUCHI, and T. FUJIMURA (Technical Research Association) /in ORNL Intern. Conf. on Welding Technol. for Energy Appl. p 71-90 Sep. 1982 refs
 Avail: NTIS HC A99/MF A01

The development of materials for energy applications is discussed, particularly high quality steels for nuclear power plants, hastelloy for structural components at extra-high temperature service, and materials for corrosion resistant pipes. Welding processes, including electron beam welding, narrow gap arc welding, and laser and diffusion welding, are also addressed. Finally, the construction of a liquefied natural gas storage tank is described. M.G.

N83-27390# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
 I. F. STOWERS, ed., R. B. CRAWFORD, ed., M. A. ESSER, ed., P. L. LIEN, ed., E. ONEAL, ed., and P. VANDYKE, ed. Jul. 1982 58 p refs
 (Contract W-7405-ENG-48)
 (DE82-019880; UCRL-52000-82-7) Avail: NTIS HC A04/MF A01

The state of the laboratory address by LLNL Director Roger Batzel is summarized, and a breakdown of the laboratory funding is given. The Livermore defense related commitment is described, including the design and development of advanced nuclear weapons as well as research in inertial confinement fusion, nonnuclear ordnance, and particle beam technology. LLNL is also applying its scientific and engineering resources to the dual challenge of meeting future energy needs without degrading the quality of the biosphere. Some representative examples are given of the supporting groups vital for providing the specialized expertise and new technologies required by the laboratory's major research programs. DOE

N83-27431# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
RENEWABLE ENERGY TECHNOLOGY HANDBOOK FOR MILITARY ENGINEERS
 Mar. 1982 338 p refs
 (Contract DE-AC02-77CH-00178)
 (DE82-017689; SERI/SP-200-1413) Avail: NTIS HC A15/MF A01

Renewable energy applications are introduced that are considered promising for military use in the 1980s. These are: solar hot water for buildings, active solar hot water and space heating for buildings, passive solar heating and cooling of buildings, solar industrial process heat, solar ponds, photovoltaic power for homes, photovoltaic power for remote applications, parabolic dish solar systems for remote applications, wind energy for buildings, wind energy for central power plants, wind energy for water pumping, biomass energy systems for buildings, biomass energy systems for central power plants, geothermal energy for process heat, and geothermal energy for central power plants. For each of these is given: a brief history of the technology and information on how the technology works; a detailed technical and economic profile of an operating system; and a summary listing of operating

civilian and military systems that are open for public viewing

DOE

N83-27530# Sandia Labs., Albuquerque, N. Mex.
SEDIMENTOLOGY OF THE MESAVERDE FORMATION OF RIFLE GAP, COLORADO AND IMPLICATIONS FOR GAS-BEARING INTERVALS IN THE SUBSURFACE

J. C. LORENZ Mar. 1982 46 p refs

(Contract DE-AC04-76DP-00789)

(DE82-013396; SAND-82-0604) Avail: NTIS HC A03/MF A01

The exposures of the Mesaverde Formation at Rifle Gap, Colorado, are of a regressive series of marine to fluvial deposits about 1650 m (5000 ft) thick. Grading up out of the marine mancos Shale, the blanket shoreline sandstones of the Corocoran, Cozzette, and Rollins Sandstones record substages of the regression as data lobes were activated and abandoned in northwestern Colorado during Late Cretaceous time. The overlying goaks, sandstones, and carbonaceous mudstones were deposited on the paludal lower delta plain behind the shoreline. Meandering fluvial systems prograded over the paludal deposits. These systems deposited point-bar sandstones and overbank mudstones and siltstones in composite meander-belt trends, some of which are now gas-bearing, low-permeability reservoirs. Reorientation of the paleogeography during the Laramide orogeny (contemporaneous with fluvial deposition) probably changed the orientation of the meander belt trends. DOE

N83-30293# South Carolina Univ., Columbia. Coll. of Engineering.

THERMODYNAMIC CONSISTENCY TEST PROCEDURE USING ORTHOGONAL COLLOCATION AND THE PENG-ROBINSON EQUATION OF STATE

L. L. HAMM and V. VANBRUNT Aug. 1982 262 p refs

(Contract W-7405-ENG-26; DE-AS05-79SR-1012;

EY-77-S-09-1012)

(DE83-007168; ORNL/SUB-81-1012/1) Avail: NTIS HC A12/MF A01

The Christiansen and Fredenslund programs for calculating vapor-liquid equilibria have been modified by replacing the Soave-Redlich-Kwong equation of state with the newly developed Peng-Robinson equation of state. This modification was shown to be a decided improvement for high pressure systems, especially in the critical and upper retrograde regions. Thermodynamic consistency tests were developed and used to evaluate and compare calculated values from both the modified and unmodified programs with reported experimental data for several vapor-liquid systems. DOE

N83-30303# Office of Technology Assessment, Washington, D.C. Space, Transportation, and Innovation Program.

SPACE SCIENCE RESEARCH IN THE US: A TECHNICAL MEMORANDUM

Sep. 1982 53 p

(PB83-166512; OTA-TM-STI-19; LC-82-600633) Avail: NTIS HC A04/MF A01 CSCL 05A

Selective budget cuts and reallocation of funds within the National Aeronautics and Space Administration's space science program have left planetary science, solar and heliospheric physics, gamma ray astronomy, and X-ray astronomy with uncertain futures. Many in the space science community think that the program has lost its sense of direction and that it is time for national goals for space science to be articulated. The views of many people interested in space science including those of representatives of several Federal agencies, space scientists, and staff members of congressional committees and individual Congressmen are summarized. GRA

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N83-30311# Energy Information Administration, Washington, D.C.

EIA DATA INDEX: AN ABSTRACT JOURNAL. THIRD SUPPLEMENT, JUL.-DEC. 1981

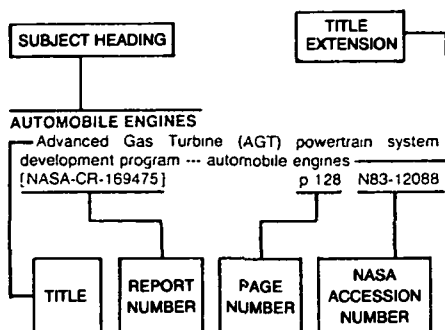
Jun. 1982 554 p

(DE83-006533; DOE/EIA-0233(81/2)) Avail: NTIS HC A24/MF A01

The Data Index includes a complete subject index, and a report number listing for all Energy Information Administration (EIA) publications as well as complete information on how to order these publications. The abstracts of the tables and graphs are arranged by broad subject categories such as coal and coal products, petroleum, natural gas, and energy analysis and modeling. These subject categories are further divided into sub-categories. Each abstract displays the following information: the report number, the page within the report on which the item can be found, the title of the table or graph, the data date, and the data source. Further, the abstract describes what data are displayed in the table or graph and how those data are aggregated. The Data Index is a companion volume to the EIA Publications Directory. A User's Guide, which provides subject access to all of the EIA publications at the document level. Together, these two directories serve as a complete abstracting and indexing service for the microfiche and hard copy publications of the Energy Information Administration.

DOE

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title, and title extension if used, provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any subject heading the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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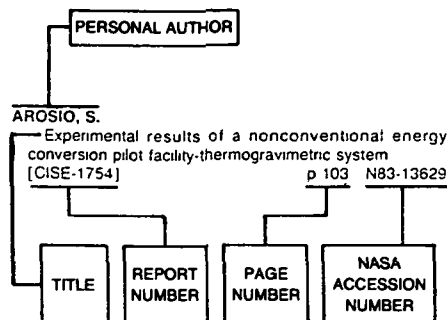
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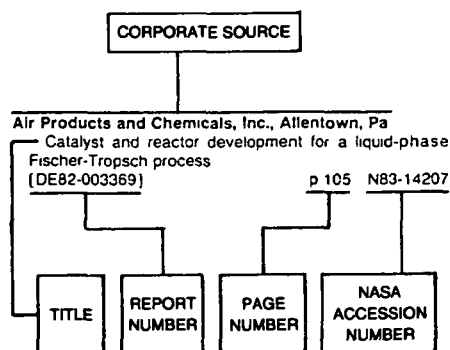
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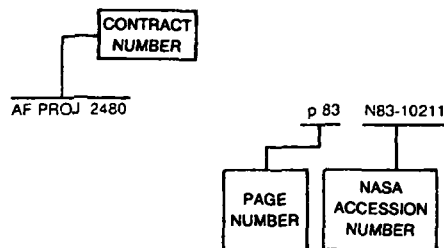
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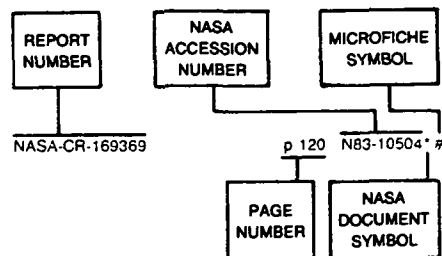
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DE82-019764	p 104	N83-23384	#	DE82-903161	p 144	N83-28133	#	DE83-005083	p 11	N83-25211	#
DE82-019768	p 127	N83-25144	#	DE82-903277	p 22	N83-29818	#	DE83-005084	p 8	N83-23870	#
DE82-019788	p 17	N83-27514	#	DE82-903595	p 142	N83-27432	#	DE83-005175	p 132	N83-26088	#
DE82-019804	p 76	N83-26269	#	DE82-905248	p 68	N83-28714	#	DE83-005189	p 71	N83-25123	#
DE82-019808	p 159	N83-29719	#	DE82-905281	p 176	N83-25152	#	DE83-005216	p 99	N83-29424	#
DE82-019835	p 117	N83-24601	#	DE82-905315	p 153	N83-28719	#	DE83-005244	p 72	N83-25168	#
DE82-019875	p 160	N83-29851	#	DE82-905355	p 182	N83-28672	#	DE83-005246	p 73	N83-25169	#
DE82-019877	p 76	N83-26271	#	DE82-905367	p 119	N83-24626	#	DE83-005269	p 73	N83-25170	#
DE82-019880	p 201	N83-27390	#	DE82-905467	p 141	N83-27356	#	DE83-005270	p 10	N83-25124	#
DE82-019929	p 105	N83-23406	#	DE82-905763	p 19	N83-28668	#	DE83-005285	p 92	N83-29832	#
DE82-019935	p 130	N83-25261	#	DE82-905768	p 22	N83-29820	#	DE83-005287	p 128	N83-25177	#
DE82-019937	p 115	N83-24016	#	DE82-905771	p 179	N83-27403	#	DE83-005297	p 143	N83-27473	#
DE82-019962	p 81	N83-27411	#	DE82-905772	p 128	N83-25182	#	DE83-005311	p 150	N83-28657	#
DE82-019964	p 81	N83-27408	#	DE82-905778	p 139	N83-27053	#	DE83-005361	p 73	N83-25171	#
DE82-019965	p 81	N83-27407	#	DE82-905784	p 77	N83-26285	#	DE83-005365	p 73	N83-25172	#
DE82-019966	p 81	N83-27412	#	DE82-906452	p 111	N83-23865	#	DE83-005377	p 72	N83-25130	#
DE82-019991	p 134	N83-26290	#	DE83-0000450	p 173	N83-23895	#	DE83-005381	p 74	N83-25202	#
DE82-020000	p 83	N83-27528	#	DE83-000079	p 66	N83-23900	#	DE83-005382	p 73	N83-25176	#
DE82-020001	p 82	N83-27423	#	DE83-000101	p 116	N83-24596	#	DE83-005407	p 91	N83-29829	#
DE82-020005	p 128	N83-25183	#	DE83-000110	p 126	N83-25133	#	DE83-005412	p 125	N83-25019	#
DE82-020050	p 127	N83-25154	#	DE83-000224	p 111	N83-23893	#	DE83-005454	p 120	N83-24717	#
DE82-020053	p 107	N83-23576	#	DE83-000309	p 117	N83-24600	#	DE83-005489	p 72	N83-25167	#
DE82-020069	p 195	N83-26291	#	DE83-000318	p 66	N83-23902	#	DE83-005500	p 109	N83-23833	#
DE82-020160	p 118	N83-24605	#	DE83-000321	p 66	N83-23903	#	DE83-005529	p 73	N83-25178	#
DE82-020164	p 118	N83-24604	#	DE83-000340	p 200	N83-23915	#	DE83-005583	p 23	N83-29879	#
DE82-020189	p 134	N83-26227	#	DE83-000396	p 120	N83-24719	#	DE83-005611	p 135	N83-26945	#
DE82-020328	p 15	N83-27471	#	DE83-000418	p 105	N83-23400	#	DE83-005655	p 10	N83-25126	#
DE82-020356	p 127	N83-25139	#	DE83-000522	p 167	N83-23541	#	DE83-005668	p 135	N83-26303	#
DE82-020457	p 127	N83-25140	#	DE83-000640	p 190	N83-23535	#	DE83-005692	p 200	N83-24687	#
DE82-020509	p 13	N83-26226	#	DE83-000653	p 113	N83-23933	#	DE83-005727	p 195	N83-25201	#
DE82-020517	p 117	N83-24599	#	DE83-000658	p 116	N83-24595	#	DE83-005728	p 193	N83-25050	#
DE82-020531	p 68	N83-23932	#	DE83-000800	p 66	N83-23891	#	DE83-005757	p 83	N83-27452	#
DE82-020532	p 68	N83-23941	#	DE83-000806	p 112	N83-23911	#	DE83-005808	p 135	N83-26305	#
DE82-020535	p 194	N83-25145	#	DE83-000855	p 111	N83-23888	#	DE83-005828	p 69	N83-24723	#
DE82-020567	p 8	N83-23936	#	DE83-000856	p 111	N83-23886	#	DE83-005870	p 161	N83-29907	#
DE82-020600	p 194	N83-25132	#	DE83-000866	p 111	N83-23889	#	DE83-005895	p 178	N83-27246	#
DE82-020604	p 112	N83-23924	#								

DE83-005936	p 19	N83-28641	#	DE83-900173	p 86	N83-28640	#	DOE/ET-10587/T1-PT-2	p 138	N83-27046	#
DE83-005947	p 99	N83-29336	#	DE83-900742	p 114	N83-23959	#	DOE/ET-10615/17-APP-8B	p 128	N83-25181	#
DE83-005956	p 137	N83-26974	#	DE83-900758	p 10	N83-25198	#	DOE/ET-10615/17	p 128	N83-25179	#
DE83-006013	p 140	N83-27245	#	DE83-900880	p 121	N83-24726	#	DOE/ET-10693/2295	p 116	N83-24596	#
DE83-006023	p 83	N83-27457	#	DE83-900881	p 121	N83-24725	#	DOE/ET-11338/1216	p 104	N83-23385	#
DE83-006027	p 82	N83-27446	#	DE83-900882	p 176	N83-25212	#	DOE/ET-11423/T3	p 119	N83-24622	#
DE83-006065	p 82	N83-27445	#	DE83-900987	p 194	N83-25121	#	DOE/ET-11423/T4	p 136	N83-26957	#
DE83-006091	p 179	N83-27443	#	DE83-900991	p 120	N83-24675	#	DOE/ET-11423/T5	p 116	N83-24597	#
DE83-006115	p 139	N83-27051	#	DE83-901132	p 196	N83-26296	#	DOE/ET-11429/T2	p 147	N83-28162	#
DE83-006116	p 83	N83-27456	#	DE83-901135	p 179	N83-27372	#	DOE/ET-12145/1	p 144	N83-28132	#
DE83-006184	p 78	N83-26302	#	DE83-901448	p 144	N83-28122	#	DOE/ET-12231/T1	p 172	N83-23853	#
DE83-006235	p 161	N83-30218	#	DE83-901449	p 181	N83-28638	#	DOE/ET-12512/2	p 8	N83-23965	#
DE83-006243	p 142	N83-27444	#	DE83-901452	p 159	N83-29715	#	DOE/ET-12581/T1	p 194	N83-25145	#
DE83-006404	p 139	N83-27215	#					DOE/ET-13077/63	p 140	N83-27333	#
DE83-006415	p 92	N83-29834	#	DFVLR-FB-82-05	p 79	N83-26314	#	DOE/ET-13333/T1	p 149	N83-28273	#
DE83-006424	p 79	N83-26304	#					DOE/ET-14752/28	p 127	N83-25141	#
DE83-006471	p 160	N83-29789	#	DFVLR-MITT-83-01	p 131	N83-25841	#	DOE/ET-14759/T1-VOL-2-14	p 111	N83-23886	#
DE83-006474	p 14	N83-26741	#					DOE/ET-14759/T1-VOL-3-14	p 111	N83-23887	#
DE83-006488	p 91	N83-29831	#	DNA-6152F	p 185	N83-30238	#	DOE/ET-14759/T1-VOL-4-14	p 111	N83-23888	#
DE83-006533	p 202	N83-30311	#					DOE/ET-14759/T1-VOL-5-14	p 111	N83-23889	#
DE83-006573	p 148	N83-28262	#	DOE/AF-92017/T2	p 120	N83-24716	#	DOE/ET-14759/T7-36	p 112	N83-23905	#
DE83-006579	p 156	N83-29335	#	DOE/AF-92017/T3	p 153	N83-28732	#	DOE/ET-14858/T2	p 157	N83-29434	#
DE83-006616	p 149	N83-28456	#					DOE/ET-14880/09	p 104	N83-23384	#
DE83-006665	p 78	N83-26301	#	DOE/AL-19929/T1	p 86	N83-28643	#	DOE/ET-14881/9	p 155	N83-29331	#
DE83-006685	p 23	N83-30087	#					DOE/ET-14884/1224	p 136	N83-26964	#
DE83-006695	p 17	N83-27511	#	DOE/BC-10003/26	p 108	N83-23684	#	DOE/ET-15288/1	p 136	N83-26963	#
DE83-006696	p 179	N83-27387	#	DOE/BC-10430/1	p 120	N83-24719	#	DOE/ET-15611/T5	p 182	N83-28669	#
DE83-006700	p 197	N83-27382	#	DOE/BC-10467-13	p 149	N83-28456	#	DOE/ET-15611/9	p 183	N83-29061	#
DE83-006721	p 93	N83-29849	#					DOE/ET-20255/T1	p 92	N83-29832	#
DE83-006748	p 160	N83-29848	#	DOE/BETC/OP-82/4	p 149	N83-28560	#	DOE/ET-20279/159	p 82	N83-27437	#
DE83-006812	p 93	N83-29850	#					DOE/ET-20279/162	p 70	N83-25053	#
DE83-006817	p 150	N83-28642	#	DOE/BETC/PPS-82/5	p 139	N83-27051	#	DOE/ET-20279/170	p 78	N83-26298	#
DE83-006841	p 196	N83-26306	#					DOE/ET-20279/180-VOL-5	p 73	N83-25169	#
DE83-006843	p 83	N83-27454	#	DOE/BETC/QPR-82/1	p 128	N83-25183	#	DOE/ET-20279/182	p 10	N83-25055	#
DE83-006912	p 156	N83-29343	#					DOE/ET-20279/183	p 81	N83-27399	#
DE83-006914	p 79	N83-27140	#	DOE/CE-0009/6	p 153	N83-28718	#	DOE/ET-20279/184	p 70	N83-25054	#
DE83-006955	p 86	N83-28648	#					DOE/ET-20279/185	p 70	N83-25052	#
DE83-006997	p 86	N83-28643	#	DOE/CH-10047/4	p 116	N83-24259	#	DOE/ET-20279/195	p 75	N83-25914	#
DE83-007042	p 79	N83-27357	#	DOE/CH-10122/2	p 68	N83-23941	#	DOE/ET-20279/206	p 19	N83-28728	#
DE83-007051	p 179	N83-27394	#	DOE/CH-10122/3	p 68	N83-23932	#	DOE/ET-20279/219	p 90	N83-28737	#
DE83-007103	p 143	N83-27525	#					DOE/ET-20279/228	p 67	N83-23908	#
DE83-007143	p 181	N83-28645	#	DOE/CS-0127/3	p 78	N83-26301	#	DOE/ET-20279/230	p 66	N83-23896	#
DE83-007168	p 201	N83-30293	#	DOE/CS-20038/T8	p 150	N83-28642	#	DOE/ET-20279/237	p 79	N83-27140	#
DE83-007171	p 199	N83-29827	#	DOE/CS-20436/T1	p 13	N83-26307	#	DOE/ET-20622/1	p 16	N83-27472	#
DE83-007197	p 179	N83-27461	#	DOE/CS-24312/1	p 15	N83-27471	#	DOE/ET-20647/1	p 142	N83-27426	#
DE83-007217	p 143	N83-27450	#	DOE/CS-24312/3	p 17	N83-27514	#	DOE/ET-20651/T2	p 126	N83-25122	#
DE83-007218	p 196	N83-26931	#	DOE/CS-30339/T1	p 4	N83-23332	#	DOE/ET-20734/T1	p 112	N83-23924	#
DE83-007225	p 141	N83-27395	#	DOE/CS-30571/T2	p 87	N83-28665	#	DOE/ET-27111/7	p 20	N83-28766	#
DE83-007227	p 196	N83-27061	#	DOE/CS-31591/T8	p 91	N83-29829	#	DOE/ET-27112/3	p 135	N83-26303	#
DE83-007310	p 85	N83-28635	#	DOE/CS-32117/2	p 92	N83-29840	#	DOE/ET-27196/T8	p 113	N83-23949	#
DE83-007342	p 140	N83-27241	#	DOE/CS-34281/2	p 89	N83-28729	#	DOE/ET-27204/T1-VOL-2-SECT-2	p 160	N83-29786	#
DE83-007385	p 141	N83-27385	#	DOE/CS-35100/T1	p 82	N83-27445	#	DOE/ET-27204/T1-V2-APP-SECT-5	p 141	N83-27338	#
DE83-007415	p 141	N83-27391	#	DOE/CS-40337/13	p 181	N83-28645	#	DOE/ET-28365/24	p 152	N83-28704	#
DE83-007436	p 158	N83-29435	#	DOE/CS-40337/6	p 11	N83-25211	#	DOE/ET-28365/26	p 152	N83-28703	#
DE83-007443	p 157	N83-29431	#	DOE/CS-40337/7	p 8	N83-23870	#	DOE/ET-28365/27	p 160	N83-29836	#
DE83-007450	p 157	N83-29433	#	DOE/CS-40377/1	p 10	N83-25126	#	DOE/ET-28933/91	p 160	N83-29790	#
DE83-007461	p 85	N83-28636	#	DOE/CS-50026/1	p 120	N83-24721	#	DOE/ET-41900/17	p 161	N83-30218	#
DE83-007539	p 18	N83-28277	#	DOE/CS-50286/3	p 140	N83-27245	#				
DE83-007586	p 16	N83-27481	#	DOE/CS-56051/8-VOL-2	p 138	N83-27036	#	DOE/EV-10021/T1	p 23	N83-29937	#
DE83-007658	p 16	N83-27500	#					DOE/EV-10298/4	p 8	N83-23963	#
DE83-007659	p 17	N83-27501	#	DOE/CS/30586-1	p 196	N83-27061	#	DOE/EV-10450/T2	p 78	N83-26297	#
DE83-007865	p 183	N83-28740	#					DOE/EV-10659/T1	p 121	N83-24739	#
DE83-008127	p 138	N83-27036	#	DOE/EIA-0149(77-81)	p 14	N83-26741	#	DOE/EV-70048/T1	p 154	N83-28763	#
DE83-008130	p 148	N83-28261	#	DOE/EIA-0233(81/2)	p 202	N83-30311	#				
DE83-008133	p 80	N83-27386	#	DOE/EIA-0280(80)	p 160	N83-29789	#	DOE/FC-1008	p 148	N83-28262	#
DE83-008259	p 90	N83-28737	#	DOE/EIA-0333	p 13	N83-26226	#				
DE83-008313	p 17	N83-27502	#	DOE/EIA-0338	p 140	N83-27334	#	DOE/FE-00094/T1	p 134	N83-26290	#
DE83-008472	p 149	N83-28275	#					DOE/FE-0023	p 148	N83-28269	#
DE83-008484	p 92	N83-29840	#	DOE/EML-407	p 68	N83-23938	#	DOE/FE-05157/2	p 111	N83-23893	#
DE83-008661	p 88	N83-28707	#								
DE83-008670	p 185	N83-29847	#	DOE/EP-0079	p 120	N83-24717	#	DOE/IA-0010/18	p 22	N83-29824	#
DE83-008964	p 154	N83-28811	#	DOE/EP-0080	p 10	N83-25124	#				
DE83-009089	p 91	N83-29641	#					DOE/ID-12009/T2	p 113	N83-23928	#
DE83-009096	p 152	N83-28704	#	DOE/ER-0123	p 200	N83-25056	#	DOE/ID-12009/T3	p 112	N83-23925	#
DE83-009097	p 152	N83-28703	#	DOE/ER-0145	p 108	N83-23648	#	DOE/ID-12009/T4	p 19	N83-28730	#
DE83-009124	p 155	N83-29332	#	DOE/ER-0150	p 11	N83-25210	#	DOE/ID-12026/T1	p 115	N83-24023	#
DE83-009191	p 147	N83-28219	#	DOE/ER-04169/7	p 146	N83-28149	#	DOE/ID-12026/T2	p 115	N83-24022	#
DE83-009213	p 153	N83-28708	#	DOE/ER-10063/T1	p 181	N83-28458	#	DOE/ID-12030/T3	p 125	N83-25023	#
DE83-009343	p 19	N83-28730	#	DOE/ER-10066/T2	p 146	N83-28151	#	DOE/ID-12079/57	p 130	N83-25261	#
DE83-009359	p 153	N83-28709	#	DOE/ER-10068/T1	p 146	N83-28150	#	DOE/ID-12079/58	p 115	N83-24016	#
DE83-009382	p 182	N83-28713	#	DOE/ER-10366/4	p 173	N83-23884	#	DOE/ID-12154/T2	p 150	N83-28675	#
DE83-009389	p 182	N83-28711	#	DOE/ER-10558/3	p 66	N83-23892	#	DOE/ID-12277/T1-VOL-2	p 112	N83-23911	#
DE83-009470	p 199	N83-28712	#	DOE/ER-30015/T1	p 118	N83-24618	#	DOE/ID-12321/T1	p 157	N83-29423	#
DE83-009665	p 157	N83-29423	#								
DE83-009737	p 92	N83-29843	#	DOE/ET-00277/T1	p 142	N83-27444	#	DOE/JPL-1060/58	p 59	N83-23705*	#
DE83-009763	p 99	N83-29845	#	DOE/ET-10104/31	p 147	N83-28165	#	DOE/JPL-954373-81/19	p 69	N83-25027*	#
DE83-009816	p 160	N83-29836	#	DOE/ET-10104/52-VOL-3-PT-6	p 146	N83-28160	#	DOE/JPL-955506-83/3	p 59	N83-23701*	#
DE83-009863	p 92	N83-29841	#	DOE/ET-10104/55	p 137	N83-26966	#	DOE/JPL-955676-4	p 59	N83-23700*	#
DE83-010232	p 92	N83-29842	#	DOE/ET-10112/T1	p 117	N83-24601	#				
DE83-010293	p 92	N83-29838	#	DOE/ET-10137/T4	p 105	N83-23406	#	DOE/LC-10335/T1	p 160	N83-29848	#
DE83-010390	p 93	N83-29844	#	DOE/ET-10152/T11-VOL-2	p 129	N83-25187	#	DOE/LC-10703/T1	p 134	N83-26295	#
DE83-010852	p 153	N83-28742	#	DOE/ET-10154/110	p 126	N83-25133	#	DOE/LC-10787/89	p 152	N83-28698	#
DE83-011017	p 154	N83-28812	#	DOE/ET-10261/T5-VOL-4	p 11	N83-25231	#				
DE83-020773	p 194	N83-25156	#	DOE/ET-10280/T3	p 142	N83-27406	#	DOE/MC-08199/T12	p 115	N83-24020	#
DE83-021710	p 173	N83-23945	#	DOE/ET-10546/T1	p 137	N83-26965	#	DOE/MC-14129/1309	p 137	N83-26974	#
DE83-900127	p 112	N83-23913	#	DOE/ET-10587/T1-PT-1	p 146	N83-28161	#	DOE/MC-14380/1210-VOL-1	p 137	N83-26972	#

DOE/MC-14394/1365	p 154	N83-28811 #	DOE/R5-10252/2	p 73	N83-25170 #	EPRI-EM-2573-VOL-2	p 196	N83-26296 #
DOE/MC-14591/T2	p 136	N83-26959 #	DOE/R5-10298/T2	p 83	N83-27457 #	EPRI-EM-2695-VOL-1	p 10	N83-25198 #
DOE/MC-14591/1173	p 136	N83-26960 #	DOE/R5-10298/2	p 83	N83-29850 #	EPRI-EM-2780	p 194	N83-25121 #
DOE/MC-14593/T6	p 105	N83-23400 #	DOE/R5-10311/2	p 173	N83-23890 #			
DOE/MC-14693/1296-VOL-2	p 149	N83-28561 #	DOE/R5-10333/3	p 71	N83-25123 #	EPRI-RD-2369-SR	p 106	N83-23444 #
DOE/MC-16024/T3	p 117	N83-24598 #	DOE/R5/10297/T2	p 144	N83-28125 #			
DOE/MC-16372/56	p 140	N83-27337 #				ESA-CR(P)-1696	p 79	N83-26313 #
DOE/MC-16463/1324	p 125	N83-25019 #	DOE/SF-10542/T1	p 68	N83-23940 #	ESA-CR(P)-1700	p 188	N83-26038 #
DOE/MC-19170/1168	p 11	N83-25219 #	DOE/SF-10855-82/4	p 111	N83-23857 #			
			DOE/SF-11429/1	p 130	N83-25209 #	ESA-SP-181	p 59	N83-23743 #
DOE/METC-82/24	p 129	N83-25166 #	DOE/SF-11503/T2	p 141	N83-27391 #			
DOE/METC-82/42-VOL-1	p 17	N83-27511 #	DOE/SF-11566/2-VOL-1	p 91	N83-29815 #	ESA-TT-775	p 79	N83-26314 #
			DOE/SF-11566/2-VOL-2	p 91	N83-29816 #			
DOE/NASA/0032-81/11	p 178	N83-26762* #	DOE/SF-11567/1	p 77	N83-26286 #	ESD-PUBL-1848	p 20	N83-28758 #
DOE/NASA/0051-3	p 177	N83-26259* #	DOE/SF-11578/T1	p 89	N83-28735 #			
DOE/NASA/0287-1	p 156	N83-29359* #	DOE/SR-0007	p 155	N83-29022 #	ESG-DOE-13377QTPR-3	p 103	N83-23373 #
DOE/NASA/0292-1	p 150	N83-28580* #				ESG-DOE-13387	p 87	N83-28663 #
DOE/NASA/0292-1	p 150	N83-28581* #	DOE/TIC/EGC-82/2	p 7	N83-23864 #	ESG-DOE-13391	p 161	N83-30218 #
DOE/NASA/12726-21	p 192	N83-25042* #						
DOE/NASA/12726-22	p 184	N83-29810* #	DOT-1-82-50	p 12	N83-25919 #	ESL-70	p 130	N83-25261 #
DOE/NASA/20485-14	p 59	N83-23709* #				ESL-71	p 115	N83-24016 #
DOE/NASA/20485-15	p 70	N83-25041* #	DRL-58-DRD-SE-7	p 69	N83-25027* #			
DOE/NASA/51040-48	p 18	N83-27924* #				EUR-7068-EN	p 176	N83-25844 #
			E-1421-3	p 176	N83-25625* #	EUR-7095-FR	p 68	N83-23952 #
DOE/NBM-1004-VOL-2	p 5	N83-23721 #	E-1535	p 187	N83-24552* #			
DOE/NBM-2009090	p 141	N83-27388 #	E-1549	p 125	N83-25037* #	E83-10295	p 125	N83-24998* #
DOE/NBM-2017287	p 184	N83-29814 #	E-1642	p 70	N83-25041* #	E83-10325	p 140	N83-27310* #
DOE/NBM-2017678	p 88	N83-28700 #	E-1643	p 192	N83-25038* #	E83-10330	p 133	N83-26153* #
DOE/NBM-2020001	p 82	N83-27423 #	E-1645	p 59	N83-23709* #	E83-10335	p 133	N83-26155* #
DOE/NBM-202000	p 83	N83-27528 #	E-1662	p 192	N83-25042* #	E83-10336	p 133	N83-26176* #
DOE/NBM-3002939	p 8	N83-23970 #	E-1663	p 192	N83-24571* #			
DOE/NBM-3006116	p 83	N83-27456 #	E-1679	p 184	N83-29810* #	FAA-CT-82-116	p 106	N83-23466 #
			E-1683	p 18	N83-27924* #	FAA-CT-82-117	p 103	N83-23308 #
DOE/NE-10189/1	p 152	N83-28702 #	E-1753	p 155	N83-29236* #			
						FE-MIT-2295T26	p 116	N83-24596 #
DOE/NV-10054/3	p 154	N83-28806 #	EDA-82-0060	p 132	N83-25909 #			
DOE/NV-10174/1	p 143	N83-27473 #				FE-1147-30	p 105	N83-23406 #
			EDB-150600	p 161	N83-29907 #	FE-2013-20	p 145	N83-28136 #
DOE/OR-03054/T11	p 119	N83-24627 #	EGG-FM-6187	p 147	N83-28219 #	FE-2029-10	p 137	N83-26965 #
DOE/OR-20807-T1-VOL-6	p 18	N83-28277 #	EGG-GTH-5960	p 105	N83-23390 #	FE-2030-17-APP-8B	p 128	N83-25181 #
DOE/OR-20807/T1-VOL-1	p 158	N83-29435 #				FE-2030-17	p 128	N83-25179 #
DOE/OR-20807/T1-VOL-2A	p 157	N83-29431 #	EGG-M-12482	p 183	N83-28734 #	FE-2291-106A	p 178	N83-27246 #
DOE/OR-20807/T1-VOL-4	p 157	N83-29433 #	EGG-M-29082	p 23	N83-29879 #	FE-2433-27-VOL-4	p 11	N83-25231 #
						FE-2494-FR-1	p 146	N83-28161 #
DOE/PC-30013/6	p 108	N83-23685 #	EGG-2149	p 154	N83-28805 #	FE-2494-FR-2	p 138	N83-27046 #
DOE/PC-30018/3	p 103	N83-23373 #	EGG-2151	p 125	N83-25018 #	FE-2547-46-VOL-2	p 129	N83-25187 #
DOE/PC-30041/T8	p 119	N83-24624 #	EGG-2154	p 150	N83-28676 #	FE-2676-8	p 117	N83-24601 #
DOE/PC-30075/10	p 119	N83-24625 #	EGG-2213	p 113	N83-23933 #			
DOE/PC-30142/T4	p 107	N83-23479 #	ENICO-1106	p 118	N83-24610 #	FRDR-53	p 146	N83-28160 #
DOE/PC-30228/T4	p 137	N83-26971 #	ENICO-1112	p 135	N83-26952 #			
DOE/PC-30246/1237	p 105	N83-23389 #	EP-45	p 9	N83-24430 #	FTD-ID(RS)T-1611-82	p 183	N83-29239 #
DOE/PC-30292/8	p 135	N83-26945 #	EPA-AA-TEB-83-1	p 22	N83-29724 #			
DOE/PC-30293/6	p 145	N83-28139 #	EPA-450/3-81-005B-VOL-2	p 9	N83-23984 #	FUB-12-1982	p 79	N83-26356 #
DOE/PC-30293/7	p 117	N83-24599 #	EPA-460/3-82-003	p 159	N83-29722 #	FWS/OBS-80/22	p 13	N83-26238 #
DOE/PC-30293/8	p 130	N83-25837 #	EPA-600/2-83-010	p 23	N83-30316 #	FZL-8110-V/5	p 181	N83-28460 #
DOE/PC-30298/T7	p 136	N83-26958 #	EPA-600/7-83-008	p 21	N83-28776 #	GA-A16493	p 69	N83-24723 #
DOE/PC-30298/T8	p 106	N83-23412 #	EPA/AA/CTAB/FE/82-6	p 159	N83-29721 #	GAO/RCED-83-106	p 11	N83-25624 #
DOE/PC-30306/T7	p 145	N83-28138 #	EPA/AA/CTAB/PA/82-8	p 21	N83-29441 #	GJBX-141-82	p 134	N83-26227 #
DOE/PC-40005/20	p 117	N83-24600 #	EPA/AA/CTAB/TA/82-2	p 14	N83-26766 #	GJBX-171-82	p 125	N83-25022 #
DOE/PC-40091/T1	p 145	N83-28135 #	EPRI-AP-2162	p 172	N83-23862 #	GKSS-82/E/39	p 177	N83-26312 #
DOE/PC-40265/5	p 117	N83-24602 #	EPRI-AP-2205	p 108	N83-23625 #			
DOE/PC-40276/T2	p 137	N83-26970 #	EPRI-AP-2216	p 119	N83-24626 #	GPO-09-140	p 5	N83-23716 #
DOE/PC-40280/T5	p 107	N83-23568 #	EPRI-AP-2245	p 114	N83-23968 #	GPO-11-566	p 5	N83-23715 #
DOE/PC-40781/T3	p 145	N83-28136 #	EPRI-AP-2254	p 183	N83-29063 #	GPO-12-626	p 21	N83-29412 #
DOE/PC-40782/T2	p 104	N83-23386 #	EPRI-AP-2398-54	p 77	N83-26285 #	GPO-12-821	p 23	N83-30236 #
DOE/PC-40783/T6	p 20	N83-28762 #	EPRI-AP-2456	p 176	N83-25152 #	GPO-89-081	p 9	N83-24429 #
DOE/PC-40785/4	p 118	N83-24608 #	EPRI-AP-2518	p 111	N83-23865 #	GPO-94-897	p 5	N83-23717 #
DOE/PC-40805/1	p 21	N83-28778 #	EPRI-AP-2737	p 120	N83-24675 #	GPO-95-065	p 5	N83-23718 #
DOE/PC-40805/2	p 145	N83-28140 #	EPRI-AP-2760	p 179	N83-27372 #	GPO-96-481	p 21	N83-29413 #
DOE/PC-42682/T2	p 155	N83-29020 #	EPRI-AP-2796	p 181	N83-28638 #	GPO-99-908	p 22	N83-29807 #
DOE/PC-50804/1	p 156	N83-29335 #	EPRI-AP-2822-VOL-1	p 159	N83-29715 #			
			EPRI-AP-2845	p 144	N83-28122 #	GRI-80/0128	p 131	N83-25849* #
DOE/RA-23211/4	p 175	N83-25127 #	EPRI-CS-2409	p 182	N83-28672 #	GRI-80/0158	p 22	N83-29480 #
DOE/RA-50076/13	p 150	N83-28657 #	EPRI-CS-2452	p 128	N83-25182 #	GRI-80/0172	p 91	N83-29477 #
DOE/RA-50076/14	p 128	N83-25177 #	EPRI-CS-2574	p 114	N83-23974 #	GRI-81-0097	p 158	N83-29444 #
DOE/RA-50076/1	p 126	N83-25119 #	EPRI-CS-2634	p 114	N83-23959 #	GRI-81-0118	p 158	N83-29438 #
DOE/RA-50076/2	p 130	N83-25214 #	EPRI-EA-1572-VOL-1	p 22	N83-29818 #	GRI-81-0109	p 91	N83-29479 #
DOE/RA-50076/3	p 126	N83-25120 #	EPRI-EA-2358-VOL-2	p 139	N83-27053 #	GRI-81/0107	p 131	N83-25848 #
DOE/RA-50076/5	p 129	N83-25205 #	EPRI-EA-2442	p 22	N83-29820 #	GRI-81/10054	p 68	N83-23950 #
DOE/RA-50076/6	p 129	N83-25206 #	EPRI-EM-2351-VOL-7	p 193	N83-25050 #	GRI-82-0024	p 159	N83-29445 #
DOE/RA-50076/7	p 129	N83-25208 #	EPRI-EM-2351-VOL-9	p 195	N83-25201 #	GRI-82/0012	p 22	N83-29478 #
DOE/RA-50076/8	p 129	N83-25207 #	EPRI-EM-2407	p 179	N83-27403 #	GRI-82/0020	p 96	N83-23482 #
DOE/RA-50338/1-VOL-1-ATTACH-A	p 112	N83-23912 #				GRI-82/0027	p 183	N83-28749 #
DOE/RA-50381/1156-EXEC-SUMM	p 157	N83-29418 #				GRI-83-0001	p 156	N83-29350 #
DOE/RA-50552/1220-VOL-2	p 129	N83-25185 #						
DOE/RA-50552/1220	p 128	N83-25184 #				GSRMP-12	p 154	N83-28812 #
DOE/RL-00600/T2	p 182	N83-28670 #				GTEC-31-3725(5)	p 178	N83-26763* #
DOE/RL-82/1	p 155	N83-29022 #				H-REPT-97-570	p 9	N83-24429 #
DOE/R4-20004/T7	p 19	N83-28699 #						
DOE/R5-10109/1	p 179	N83-27387 #						
DOE/R5-10237/1	p 173	N83-23885 #						
DOE/R5-10242/T1	p 174	N83-23947 #						
DOE/R5-10251/T1	p 10	N83-25138 #						

H-REPT-98-223	p 14	N83-26755 #	LA-UR-82-584	p 83	N83-28128 #	NAS 1 26 170280	p 120	N83-24711* #
HL83/146(C14)	p 138	N83-27031 #	LA-UR-82-671	p 20	N83-28757 #	NAS 1 26 170297	p 59	N83-23705* #
			LA-UR-82-871	p 87	N83-28661 #	NAS 1 26 170298	p 59	N83-23588* #
HONEYWELL-83SRC22	p 69	N83-25040* #	LA-9083-TASE	p 86	N83-28660 #	NAS 1 26 170326	p 125	N83-24998* #
HTGL-203	p 182	N83-28669 #	LA-9098-MS	p 154	N83-28765 #	NAS 1 26 170353	p 131	N83-25849* #
HTGL-231	p 167	N83-23541 #	LA-9222-HDR	p 178	N83-27166 #	NAS 1 26 170383	p 140	N83-27310* #
			LA-9251-MS	p 108	N83-23680 #	NAS 1 26 170385	p 133	N83-26153* #
IIT-TR-82-3	p 181	N83-28645 #	LA-9275-HDR	p 154	N83-28804 #	NAS 1 26 170754	p 69	N83-25040* #
			LA-9286-PR	p 89	N83-28723 #	NAS 1 26 171641	p 188	N83-24806* #
IS-M-382	p 119	N83-24623 #	LA-9299-MS	p 75	N83-26257 #	NAS 1 26 172631	p 180	N83-27836* #
			LA-9300-MS	p 19	N83-28667 #	NAS 1 26 172648	p 13	N83-26256* #
			LA-9313-MS	p 14	N83-26764 #	NAS 1 26 172679	p 196	N83-27351* #
ISBN-0-11-4109-5-X	p 9	N83-24430 #	LA-9414-MS	p 8	N83-23962 #	NAS 1 26 172680	p 197	N83-27352* #
ISBN-0-902937-63-4	p 157	N83-29414 #	LA-9458-T	p 180	N83-27837 #	NAS 1 55 2261-VOL-1	p 133	N83-26155* #
			LA-9479-PR	p 108	N83-23619 #	NAS 1 55 2261-VOL-2	p 133	N83-26176* #
			LA-9483-MS	p 7	N83-23863 #	NAS 1 55 2273	p 69	N83-24881* #
ISSN-0340-7608	p 104	N83-23374 #	LA-9485-MS	p 180	N83-27836* #	NASA-CASE-LAR-12495-1	p 84	N83-28573* #
ISSN-0340-7608	p 6	N83-23777 #	LA-9498-MS	p 72	N83-25129 #	NASA-CASE-LEW-12950-2	p 184	N83-29804* #
ISSN-0340-7608	p 62	N83-23778 #	LA-9543-MS	p 143	N83-27525 #	NASA-CASE-LEW-13827-1	p 75	N83-26258* #
ISSN-0340-7608	p 169	N83-23779 #	LA-9625-HDR					
ISSN-0340-7608	p 170	N83-23780 #						
ISSN-0340-7608	p 170	N83-23781 #	LBL-12753	p 87	N83-28662 #	NASA-CASE-MFS-25302-1	p 181	N83-28319* #
ISSN-0340-7608	p 170	N83-23782 #	LBL-13496	p 86	N83-28648 #	NASA-CASE-MFS-25302-2	p 174	N83-24768* #
ISSN-0340-7608	p 170	N83-23783 #	LBL-13600	p 122	N83-24933 #			
ISSN-0340-7608	p 63	N83-23784 #	LBL-13950	p 131	N83-25839 #	NASA-CASE-NPO-15458-1	p 75	N83-25587* #
ISSN-0340-7608	p 63	N83-23785 #	LBL-14111	p 84	N83-28286 #			
ISSN-0340-7608	p 109	N83-23786 #	LBL-14155	p 148	N83-28264 #	NASA-CP-2261-VOL-1	p 133	N83-26155* #
ISSN-0340-7608	p 63	N83-23787 #	LBL-14164	p 11	N83-25233 #	NASA-CP-2261-VOL-2	p 133	N83-26176* #
ISSN-0340-7608	p 6	N83-23788 #	LBL-14216	p 144	N83-28126 #	NASA-CP-2273	p 69	N83-24881* #
ISSN-0340-7608	p 6	N83-23789 #	LBL-14303	p 75	N83-25840 #			
ISSN-0340-7608	p 170	N83-23790 #	LBL-14304	p 194	N83-25132 #	NASA-CR-165263	p 178	N83-26762* #
ISSN-0340-7608	p 116	N83-24316 #	LBL-14438	p 15	N83-27469 #	NASA-CR-165445	p 177	N83-26259* #
ISSN-0340-7608	p 147	N83-28168 #	LBL-14491	p 104	N83-23388 #	NASA-CR-166124	p 177	N83-26645* #
ISSN-0340-7608	p 90	N83-28743 #	LBL-14496	p 130	N83-25334 #	NASA-CR-168021	p 15	N83-27348* #
ISSN-0340-7608	p 90	N83-28744 #	LBL-14534	p 113	N83-23937 #	NASA-CR-168061	p 156	N83-29359* #
ISSN-0340-7608	p 19	N83-28745 #	LBL-14576	p 89	N83-28724 #	NASA-CR-168074	p 18	N83-27925* #
ISSN-0340-7608	p 90	N83-28746 #	LBL-14578	p 182	N83-28725 #	NASA-CR-168090	p 150	N83-28581* #
ISSN-0340-7608	p 184	N83-29407 #	LBL-14605	p 154	N83-28812 #	NASA-CR-168093	p 150	N83-28580* #
ISSN-0340-7608	p 184	N83-29408 #	LBL-14788	p 8	N83-23921 #	NASA-CR-168104	p 178	N83-26763* #
ISSN-0340-7608	p 160	N83-29869 #	LBL-14799	p 174	N83-23981 #	NASA-CR-168138	p 106	N83-23464* #
ISSN-0344-9629	p 177	N83-26312 #	LBL-14815	p 191	N83-24388 #	NASA-CR-170213	p 69	N83-25027* #
ISSN-0347-0881	p 193	N83-25048 #	LBL-14894	p 161	N83-29907 #	NASA-CR-170239	p 59	N83-23700* #
ISSN-0379-6566	p 59	N83-23743 #	LBL-15073	p 115	N83-24011 #	NASA-CR-170243	p 5	N83-23697* #
			LBL-15258	p 79	N83-27357 #	NASA-CR-170244	p 59	N83-23701* #
			LBL-15398	p 156	N83-29343 #	NASA-CR-170280	p 120	N83-24711* #
JACKFAU-82-299-VOL-1	p 150	N83-28581* #				NASA-CR-170297	p 59	N83-23705* #
JACKFAU-82-299-VOL-4	p 150	N83-28580* #				NASA-CR-170298	p 59	N83-23588* #
JAYCOR-J207-82-009	p 185	N83-30238 #	LC-82-600620	p 13	N83-26238 #	NASA-CR-170326	p 125	N83-24998* #
			LC-82-600633	p 201	N83-30303 #	NASA-CR-170353	p 131	N83-25849* #
			LC-83-600161	p 178	N83-27200* #	NASA-CR-170383	p 140	N83-27310* #
JHU/APL/OQR/82-2	p 177	N83-26316 #	MDC-G-8544-VOL-1	p 85	N83-28639 #	NASA-CR-170385	p 133	N83-26153* #
JPL-Pub-82-80	p 120	N83-24711* #	MDH-III-82-072	p 185	N83-29863 #	NASA-CR-170754	p 69	N83-25040* #
JPL-PUB-83-2	p 59	N83-23705* #	ME-TSPC-TR-82-12	p 137	N83-26965 #	NASA-CR-171641	p 188	N83-24806* #
JPL-PUBL-83-40	p 13	N83-26256* #	MIT-EL-82-009	p 13	N83-26308 #	NASA-CR-172631	p 180	N83-27836* #
			MLM-2951-(OP)			NASA-CR-172648	p 13	N83-26256* #
JPL-5105-122	p 59	N83-23705* #	MTI-81ASE-185QT-11	p 132	N83-26051 #	NASA-CR-172679	p 196	N83-27351* #
JPL-9950-793	p 5	N83-23697* #				NASA-CR-172680	p 197	N83-27352* #
JPL-9950-797	p 69	N83-25027* #						
JPL-9950-808	p 59	N83-23700* #				NASA-SP-464	p 178	N83-27200* #
JPL-9950-815	p 59	N83-23701* #						
JPM/LN/H05/N106	p 188	N83-26038 #	MTR-81W223	p 178	N83-26762* #	NASA-TM-77045	p 167	N83-23371* #
			MTR-82W32	p 15	N83-27469 #	NASA-TM-82867	p 83	N83-28071* #
			MTR-82W59	p 142	N83-27406 #	NASA-TM-82892	p 176	N83-25625* #
K/CSD/INF-82-6	p 4	N83-23490 #		p 74	N83-25215 #	NASA-TM-83064	p 187	N83-24552* #
K/CSD/INF-82/6-RI	p 5	N83-23491 #	NAS 1 15 77045	p 167	N83-23371* #	NASA-TM-83310	p 125	N83-25037* #
K/UR-451	p 125	N83-25022 #	NAS 1 15 82867	p 83	N83-28071* #	NASA-TM-83374	p 70	N83-25041* #
			NAS 1 15 82992	p 176	N83-25625* #	NASA-TM-83375	p 192	N83-25038* #
LA-S-482-2	p 82	N83-27448 #	NAS 1 15 83064	p 187	N83-24552* #	NASA-TM-83377	p 59	N83-23709* #
			NAS 1 15 83310	p 125	N83-25037* #	NASA-TM-83385	p 192	N83-25042* #
			NAS 1 15 83374	p 70	N83-25041* #	NASA-TM-83386	p 192	N83-24571* #
LA-UR-81-1054	p 188	N83-24819* #	NAS 1 15 83375	p 192	N83-25038* #	NASA-TM-83401	p 184	N83-29810* #
LA-UR-81-1578	p 115	N83-24024 #	NAS 1 15 83377	p 59	N83-23709* #	NASA-TM-83405	p 18	N83-27924* #
LA-UR-82-1156	p 149	N83-28497 #	NAS 1 15 83385	p 192	N83-25042* #	NASA-TM-85642	p 155	N83-29236* #
LA-UR-82-1190	p 20	N83-28753 #	NAS 1 15 83386	p 192	N83-24571* #		p 12	N83-25707* #
LA-UR-82-1192	p 176	N83-25568 #	NAS 1 15 83401	p 184	N83-29810* #	NCEL-CR-82 030	p 10	N83-24731 #
LA-UR-82-1270	p 188	N83-24822 #	NAS 1 15 83405	p 18	N83-27924* #	NCEL-CR-82 034	p 195	N83-26268 #
LA-UR-82-1273	p 188	N83-25147 #	NAS 1 15 83447	p 155	N83-29236* #	NCEL-CR-83 003	p 13	N83-26263 #
LA-UR-82-1358	p 185	N83-30246 #	NAS 1 15 85642	p 12	N83-25707* #			
LA-UR-82-1360	p 183	N83-29027 #	NAS 1 21 464	p 178	N83-27200* #	NE-1236	p 83	N83-28071* #
LA-UR-82-1434	p 109	N83-23687 #	NAS 1 26 165263	p 178	N83-26762* #			
LA-UR-82-1480	p 180	N83-27861 #	NAS 1 26 165445	p 177	N83-26259* #	NMERI-EN-12	p 142	N83-27432 #
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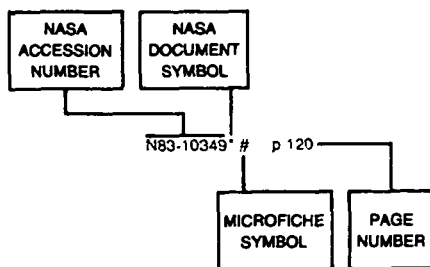
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A83-30191 #	p 161	A83-32181 #	p 27	A83-32713 #	p 164	A83-36000 #	p 52
A83-30192 #	p 162	A83-32182 #	p 27	A83-32714 #	p 45	A83-36011 #	p 52
A83-30195 #	p 162	A83-32183 #	p 27	A83-32740 #	p 46	A83-36240 #	p 101
A83-30196 #	p 99	A83-32185 #	p 27	A83-32761 #	p 187	A83-36243 #	p 101
A83-30197 #	p 99	A83-32186 #	p 27	A83-32838 #	p 46	A83-36282 #	p 3
A83-30198 #	p 162	A83-32187 #	p 27	A83-32846 #	p 46	A83-36350 #	p 166
A83-30199 #	p 162	A83-32188 #	p 27	A83-32847 #	p 46	A83-36410* #	p 166
A83-30200 #	p 162	A83-32189 #	p 27	A83-32939 #	p 100	A83-36451 #	p 166
A83-30205 #	p 24	A83-32190 #	p 28	A83-33481 #	p 100	A83-36594 #	p 52
A83-30212 #	p 24	A83-32191 #	p 28	A83-33503 #	p 1	A83-36736 #	p 52
A83-30270 #	p 24	A83-32192 #	p 28	A83-33545 #	p 1	A83-36737 #	p 52
A83-30352 #	p 162	A83-32193 #	p 28	A83-33619 #	p 187	A83-36739 #	p 52
A83-30522 #	p 162	A83-32194 #	p 28	A83-33641 #	p 200	A83-36741 #	p 52
A83-30549 #	p 163	A83-32195* #	p 28	A83-33675 #	p 46	A83-36742 #	p 52
A83-30847 #	p 24	A83-32196 #	p 28	A83-33844 #	p 46	A83-36744 #	p 53
A83-30849 #	p 24	A83-32197 #	p 29	A83-33847 #	p 47	A83-36760 #	p 3
A83-30850 #	p 24	A83-32198 #	p 29	A83-33860 #	p 47	A83-36774 #	p 53
A83-30858 #	p 163	A83-32199 #	p 29	A83-33861 #	p 47	A83-37050* #	p 53
A83-30935 #	p 163	A83-32200 #	p 29	A83-33862 #	p 94	A83-37055 #	p 53
A83-31077 #	p 163	A83-32201 #	p 29	A83-33863 #	p 47	A83-37150 #	p 53
A83-31087* #	p 163	A83-32202 #	p 29	A83-33918 #	p 47	A83-37221 #	p 166
A83-31089 #	p 163	A83-32203 #	p 30	A83-33919 #	p 47	A83-37505 #	p 166
A83-31090 #	p 189	A83-32204 #	p 30	A83-33922 #	p 47	A83-37547 #	p 190
A83-31091 #	p 189	A83-32205 #	p 30	A83-33967 #	p 47	A83-37790* #	p 53
A83-31092 #	p 164	A83-32206 #	p 30	A83-33976 #	p 165	A83-37806 #	p 96
A83-31093* #	p 164	A83-32207 #	p 30	A83-33987 #	p 47	A83-37960 #	p 101
A83-31094* #	p 164	A83-32208 #	p 30	A83-33988 #	p 165	A83-37984 #	p 3
A83-31095 #	p 164	A83-32209 #	p 31	A83-33989 #	p 48	A83-37989 #	p 3
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A83-31375 #	p 94	A83-32212 #	p 31	A83-33992 #	p 165	A83-38004 #	p 101
A83-31504 #	p 94	A83-32213 #	p 31	A83-33993 #	p 48	A83-38012 #	p 167
A83-31507 #	p 1	A83-32214 #	p 31	A83-34003 #	p 1	A83-38014 #	p 167
A83-31518 #	p 186	A83-32215 #	p 32	A83-34003 #	p 1	A83-38015* #	p 54
A83-31526* #	p 24	A83-32216 #	p 32	A83-34037 #	p 94	A83-38016 #	p 167
A83-31596 #	p 1	A83-32217 #	p 32	A83-34038 #	p 94	A83-38017 #	p 167
A83-31598 #	p 25	A83-32218 #	p 32	A83-34068 #	p 48	A83-38018 #	p 54
A83-31599 #	p 189	A83-32219 #	p 32	A83-34069 #	p 48	A83-38019 #	p 54
A83-31600 #	p 25	A83-32220 #	p 32	A83-34071 #	p 48	A83-38020 #	p 167
A83-31609 #	p 25	A83-32221 #	p 32	A83-34074 #	p 48	A83-38023* #	p 54
A83-31610 #	p 25	A83-32222 #	p 32	A83-34147 #	p 2	A83-38024 #	p 167
A83-31612 #	p 99	A83-32223 #	p 33	A83-34148 #	p 165	A83-38027 #	p 101
A83-31614 #	p 25	A83-32224* #	p 33	A83-34149 #	p 165	A83-38028 #	p 101
A83-31801 #	p 164	A83-32225 #	p 33	A83-34150 #	p 49	A83-38129 #	p 102
A83-31845 #	p 25	A83-32226 #	p 33	A83-34226 #	p 100	A83-38135 #	p 102
A83-32041 #	p 25	A83-32227 #	p 33	A83-34374 #	p 49	A83-38155 #	p 102
A83-32046 #	p 25	A83-32228 #	p 33	A83-34403 #	p 165	A83-38213 #	p 54
A83-32047 #	p 26	A83-32229 #	p 33	A83-34406 #	p 49	A83-38217 #	p 54
		A83-32230 #	p 33	A83-34407 #	p 49	A83-38337* #	p 102
		A83-32231 #	p 33	A83-34471 #	p 187	A83-38343 #	p 102
		A83-32232 #	p 33	A83-34515 #	p 49	A83-38345 #	p 102
		A83-32233 #	p 33	A83-34525 #	p 49	A83-38450 #	p 103
		A83-32234 #	p 33	A83-34651 #	p 2	A83-38622 #	p 103
		A83-32235 #	p 33	A83-34657 #	p 49	A83-38655* #	p 3
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		A83-32237 #	p 33	A83-34659 #	p 2	A83-38875 #	p 4
		A83-32238 #	p 33	A83-34660 #	p 2	A83-39126 #	p 103
		A83-32239 #	p 33	A83-34666 #	p 50	A83-39181 #	p 103
		A83-32240 #	p 33	A83-34667 #	p 50	A83-39220 #	p 4
		A83-32241 #	p 33	A83-34668 #	p 50	A83-39461 #	p 54
		A83-32242 #	p 33	A83-34671 #	p 50	A83-39462 #	p 55
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		A83-32244 #	p 33	A83-34675 #	p 51	A83-39465 #	p 55
		A83-32245 #	p 33	A83-34860 #	p 166	A83-39466 #	p 55
		A83-32246 #	p 33	A83-34866 #	p 94	A83-39560 #	p 96
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				A83-34868 #	p 95	A83-39562 #	p 96
				A83-34869 #	p 95	A83-39624 #	p 190
				A83-35301 #	p 95	A83-39849 #	p 187
				A83-35302 #	p 95	A83-39850 #	p 187
				A83-35304 #	p 95	A83-39859 #	p 200
				A83-35305 #	p 96	A83-39929 #	p 55
				A83-35404 #	p 51	A83-39930 #	p 55
				A83-35437 #	p 51	A83-39931 #	p 56
				A83-35442 #	p 51	A83-39992 #	p 103
				A83-35451 #	p 51		

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A83-40337 #	p 56	N83-23740 #	p 6	N83-23872 #	p 65	N83-24598 #	p 117	N83-25072 #	p 193
A83-40520 #	p 56	N83-23741 #	p 6	N83-23873 #	p 65	N83-24599 #	p 117	N83-25073 #	p 193
A83-40521 #	p 56	N83-23742 #	p 6	N83-23874 #	p 65	N83-24600 #	p 117	N83-25074 #	p 193
A83-40522 #	p 56	N83-23743 #	p 59	N83-23876 #	p 65	N83-24601 #	p 117	N83-25076 #	p 70
A83-40523 #	p 56	N83-23744 #	p 60	N83-23878 #	p 65	N83-24602 #	p 117	N83-25078 #	p 70
A83-40524 #	p 57	N83-23745 #	p 60	N83-23880 #	p 65	N83-24604 #	p 118	N83-25080 #	p 70
A83-40525 #	p 57	N83-23746 #	p 60	N83-23883 #	p 65	N83-24605 #	p 118	N83-25081 #	p 194
A83-40526 #	p 57	N83-23749 #	p 60	N83-23884 #	p 173	N83-24606 #	p 118	N83-25083 #	p 70
A83-40527 #	p 57	N83-23751 #	p 6	N83-23885 #	p 173	N83-24608 #	p 118	N83-25085 #	p 194
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A83-40530 #	p 57	N83-23753 #	p 60	N83-23887 #	p 111	N83-24618 #	p 118	N83-25087 #	p 71
A83-40531 #	p 58	N83-23754 #	p 60	N83-23888 #	p 111	N83-24622 #	p 119	N83-25089 #	p 71
A83-40533 #	p 58	N83-23755 #	p 60	N83-23889 #	p 111	N83-24623 #	p 119	N83-25092 #	p 71
A83-40534 #	p 58	N83-23756 #	p 60	N83-23890 #	p 173	N83-24624 #	p 119	N83-25093 #	p 71
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A83-40536 #	p 58	N83-23758 #	p 61	N83-23892 #	p 66	N83-24626 #	p 119	N83-25114 #	p 175
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		N83-23761 #	p 61	N83-23894 #	p 66	N83-24675 #	p 120	N83-25116 #	p 126
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N83-23332 #	p 4	N83-23763 #	p 61	N83-23896 #	p 66	N83-24711 #	p 120	N83-25120 #	p 126
N83-23371* #	p 167	N83-23764 #	p 61	N83-23898 #	p 111	N83-24716 #	p 120	N83-25121 #	p 194
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N83-23385 #	p 104	N83-23769 #	p 62	N83-23906 #	p 67	N83-24724 #	p 121	N83-25127 #	p 175
N83-23386 #	p 104	N83-23770 #	p 62	N83-23907 #	p 67	N83-24725 #	p 121	N83-25128 #	p 72
N83-23388 #	p 104	N83-23772 #	p 62	N83-23908 #	p 67	N83-24726 #	p 121	N83-25129 #	p 72
N83-23389 #	p 105	N83-23773 #	p 62	N83-23911 #	p 112	N83-24731 #	p 10	N83-25130 #	p 72
N83-23390 #	p 105	N83-23774 #	p 62	N83-23912 #	p 112	N83-24739 #	p 121	N83-25131 #	p 175
N83-23400 #	p 105	N83-23775 #	p 62	N83-23913 #	p 112	N83-24768 #	p 174	N83-25132 #	p 194
N83-23406 #	p 105	N83-23777 #	p 6	N83-23914 #	p 112	N83-24787 #	p 121	N83-25133 #	p 126
N83-23408 #	p 105	N83-23778 #	p 62	N83-23915 #	p 200	N83-24791 #	p 192	N83-25136 #	p 175
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N83-23444 #	p 106	N83-23782 #	p 170	N83-23924 #	p 112	N83-24881 #	p 69	N83-25141 #	p 127
N83-23484* #	p 106	N83-23783 #	p 170	N83-23925 #	p 112	N83-24921 #	p 121	N83-25142 #	p 72
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N83-23472 #	p 107	N83-23787 #	p 63	N83-23929 #	p 68	N83-24933 #	p 122	N83-25146 #	p 127
N83-23475 #	p 107	N83-23788 #	p 6	N83-23932 #	p 113	N83-24959 #	p 122	N83-25147 #	p 188
N83-23476 #	p 96	N83-23789 #	p 6	N83-23933 #	p 113	N83-24960 #	p 122	N83-25148 #	p 175
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N83-23482 #	p 96	N83-23794 #	p 109	N83-23937 #	p 113	N83-24964 #	p 123	N83-25151 #	p 175
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N83-23491 #	p 5	N83-23797 #	p 109	N83-23939 #	p 191	N83-24966 #	p 123	N83-25153 #	p 10
N83-23535 #	p 190	N83-23800 #	p 109	N83-23940 #	p 68	N83-24967 #	p 123	N83-25154 #	p 127
N83-23541 #	p 167	N83-23801 #	p 170	N83-23941 #	p 68	N83-24968 #	p 123	N83-25155 #	p 127
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N83-23568 #	p 107	N83-23809 #	p 191	N83-23946 #	p 173	N83-24971 #	p 124	N83-25164 #	p 195
N83-23576 #	p 107	N83-23810 #	p 63	N83-23947 #	p 174	N83-24977 #	p 124	N83-25165 #	p 176
N83-23588* #	p 59	N83-23811 #	p 63	N83-23948 #	p 113	N83-24978 #	p 124	N83-25167 #	p 72
N83-23619 #	p 108	N83-23813 #	p 63	N83-23949 #	p 113	N83-24979 #	p 124	N83-25168 #	p 73
N83-23625 #	p 108	N83-23814 #	p 7	N83-23950 #	p 68	N83-24980 #	p 124	N83-25169 #	p 73
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N83-23648 #	p 108	N83-23816 #	p 7	N83-23959 #	p 114	N83-24987 #	p 124	N83-25171 #	p 73
N83-23680 #	p 108	N83-23817 #	p 171	N83-23962 #	p 8	N83-24988 #	p 124	N83-25172 #	p 73
N83-23683 #	p 108	N83-23818 #	p 171	N83-23963 #	p 8	N83-24990 #	p 124	N83-25176 #	p 73
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N83-23685 #	p 108	N83-23820 #	p 63	N83-23965 #	p 8	N83-25018 #	p 125	N83-25178 #	p 128
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N83-23691 #	p 109	N83-23822 #	p 171	N83-23968 #	p 114	N83-25021 #	p 125	N83-25181 #	p 128
N83-23692 #	p 109	N83-23823 #	p 171	N83-23969 #	p 114	N83-25022 #	p 125	N83-25182 #	p 128
N83-23697* #	p 5	N83-23824 #	p 172	N83-23970 #	p 8	N83-25023 #	p 125	N83-25183 #	p 128
N83-23698* #	p 167	N83-23825 #	p 64	N83-23972* #	p 9	N83-25027* #	p 69	N83-25184 #	p 128
N83-23700* #	p 59	N83-23826 #	p 172	N83-23973 #	p 9	N83-25028* #	p 69	N83-25185 #	p 129
N83-23701* #	p 59	N83-23827 #	p 64	N83-23974 #	p 114	N83-25029* #	p 69	N83-25186 #	p 129
N83-23705* #	p 59	N83-23828 #	p 7	N83-23981 #	p 174	N83-25031* #	p 69	N83-25187 #	p 129
N83-23709* #	p 59	N83-23829 #	p 191	N83-23984 #	p 9	N83-25033* #	p 69	N83-25189 #	p 73
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N83-23716 #	p 5	N83-23831 #	p 172	N83-24016 #	p 115	N83-25038* #	p 192	N83-25191 #	p 74
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N83-23720 #	p 59	N83-23835 #	p 110	N83-24023 #	p 115	N83-25042* #	p 192	N83-25195 #	p 74
N83-23721 #	p 5	N83-23839 #	p 110	N83-24024 #	p 115	N83-25044 #	p 174	N83-25198 #	p 10
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				N83-24596 #	p 116	N83-25067 #	p 175	N83-25233 #	p 11

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N83-25262 #	p 130	N83-26371 #	p 177	N83-27412 #	p 81	N83-28272 #	p 98	N83-28711 #	p 182
N83-25333 #	p 176	N83-26411 #	p 14	N83-27414 #	p 97	N83-28273 #	p 149	N83-28712 #	p 199
N83-25334 #	p 130	N83-26445* #	p 177	N83-27419 #	p 81	N83-28274 #	p 98	N83-28713 #	p 182
N83-25568 #	p 176	N83-26741 #	p 14	N83-27421 #	p 81	N83-28275 #	p 149	N83-28714 #	p 88
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